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Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.21954/ou.ro.0000d4fc>

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THE OPEN UNIVERSITY
FACULTY OF BUSINESS AND LAW

PhD Thesis

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Bachelor of Commerce (Management)

Master of Business (Management)

Master of Research (Business and Management Research Methods)

The Disposition Effect, Dual Process Theory and Emotion Regulation

Submitted for the degree of Doctor of Philosophy in Finance

Centre of Accounting and Finance

April 26th, 2012

DATE OF SUBMISSION: 26 APRIL 2012

DATE OF AWARD: 14 JANUARY 2013

Abstract

Research from the behavioural finance paradigm has detected bias in investors' decision making. One such bias, the disposition effect, shows that investors are reluctant to sell investments at a loss, yet are eager to sell investments at a gain. Investors vary in the extent to which they exhibit the disposition effect and research to date has found that an investor's level of sophistication and amount of experience can somewhat predict their susceptibility to this bias. Despite the disposition effect arising out of the nature of human psychology, few studies have empirically investigated psychological based explanations for susceptibility to this bias. I address this gap by applying two psychological theories to predict the susceptibility to the disposition effect: dual process theory and a model of the role of emotions and their regulation.

The thesis contains two studies on the disposition effect of UK investors, a country where investors have not previously been researched for this bias. The first study involves using survival analysis to analyse the transactions made by 4,328 UK investors from July 2006 to December 2009. The second study is a subsample of the first, where 261 investors completed an online questionnaire to measure the psychological variables.

I show that the average UK investor in this sample is susceptible to the disposition effect. I contribute to existing knowledge about the disposition effect by showing that investor sophistication and experience attenuates, but does not eliminate, this bias. I extend knowledge on the disposition effect by showing that through the use of stop loss strategies, investors can inoculate against the disposition effect. In relation to the psychological variables, I find that investors who report higher levels of intuitive ability exhibit this bias to greater extent and investors who report a preference towards analytical cognition exhibit this bias to a lesser extent. Finally, the results tentatively show that investors who reappraise their emotions while investing, exhibit this bias to a lesser extent.

Acknowledgements

First of all, I would like to thank my wife, Amy Lee. Her love, support and encouragement through the hard times, made it possible for me to submit this thesis. I acknowledge the hours of proof reading she did without complaint. This PhD is for you. Thank you so much!!!

I would like to thank my supervisors, Dr. Devendra Kodwani, Prof. Janette Rutterford and Prof. Mark Fenton-O'Creevy. I feel very privileged to have had such a professional supervision team to guide me through the PhD process. I want to acknowledge the time they have taken to read my work and show my gratitude for the astute feedback you have provided. Also, thank you for me to keep my head up when things were down.

I would also like to extent my gratitude to the staff at the brokerage firm who helped collect the data and answer my questions about it. I would like to recognise the help from Steve Eyles for teaching me how to use databases and organise the trading data. Special thanks to the late Geoff Mallory for accepting me into the PhD programme and offering advice throughout my time at the Open University.

Thanks to my fellow PhD students for their chats over coffee, feedback on my presentations and sharing their ideas with me. Finally, a big thank you goes to my family and friends for keeping me sane through this process.

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Definitions of key concepts

Convergent validity: This refers to the validity of a measure based on the extent to which it relates to other measures when theory says there should be a relationship.

Corporate actions: These are actions taken by the firms which resulted in changes to their capital structure and shareholders' holding. The specific corporate actions of interest in this study are rights issues, splits, consolidations and scrip issues.

Discriminant validity: This indicates the power of a measure to discriminate between persons or situations which theory says should be different (Sapsford, 2007).

Ecological validity: This is the question of whether or not social scientific findings are applicable to people's everyday, natural social settings (Bryman and Bell, 2003).

Emotion: This is defined as intense affective experiences directed toward certain objects, such as anger and fear. Emotions should be distinguished from feelings or moods which are prolonged and diffusive state with no particular object (Seo and Barrett, 2007, p. 924).

Emotion regulation: This refers to the processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions (Gross, 1998, p. 275).

Expressive suppression: This is a method of emotion regulation which involves inhibiting ongoing emotion-expressive behaviour.

Hedonic editing: This is an aspect of mental accounting theory (Thaler, 1985) which implies that people will make decisions to maintain an acceptable level of hedonic tone (pleasurable feelings). In relation to stock market investment it is argued that investors will do the following to maintain hedonic tone: integrate losses, segregating gains, integrate smaller losses with larger gains and segregate small gains from larger losses (provided that the absolute value of the gain is significantly smaller than the absolute value of the loss) (Lehenkari, 2009).

Individual investors: Refers to investors who directly purchase shares and funds in the stock market. The individual investors in this research are trading with their own money and do so on a non-professional basis. Individual investors should be distinguished from traders. Traders will often have a shorter investment horizon, will trade in different markets, such as currency markets, and may sell short to make profit from a declining price.

Reappraisal: This is a method of emotion regulation which involves cognitively changing a situation's meaning in a way that alters its emotional impact.

Roundtrip transaction: This is a transaction cycle involving buying and selling the same amount of stock. It refers to the combined trades with which an investor has bought and sold a stock so that their holding balance returns to zero (with a sell trade).

Sophistication: This is term is used to describe investor attributes. A sophisticated investor is one with knowledge of complex investments and markets.

Short selling: This when an investor sells a financial asset that s/he does not own but borrows from a third party on the promise that s/he will return the asset at a later date. The intention of short selling is to make money when a financial asset decreases in value.

Stock: This refers to financial products which are commonly traded by investors which typically are shares, exchange traded funds, funds, unit trusts and bonds.

Stop loss: A method of automatically selling stock when it has decreased in value.

System 1: This refers to cognition which is characterised as automatic, largely unconscious, and relatively undemanding of computational capacity. Thus, it conjoins properties of automaticity and heuristic processing (Stanovich and West, 2000, p. 658).

System 2: This refers to cognition which is characterised by controlled processing. System 2 encompasses the processes of analytic intelligence (Stanovich and West, 2000, p. 658).

Trade: This refers to a purchase or sale of a stock. This represents one row of information in the investors' trading records.

Warrants: A warrant is a financial asset which is traded on the London Stock Exchange. It gives the holder the right, but not the obligation to buy or sell an underlying asset, at a specified price, on or before a predetermined date (London Stock Exchange, 2009). The essential aspect of a warrant is that a small movement in the price of the underlying asset results in a disproportionately large movement in the price of the warrant.

Chapter 1. Introduction

1.1 Rationale for research

During the 1960s and 1970s a major focus point for financial research was the efficient market hypothesis (EMH Fama, 1965, Samuelson, 1965). The EMH proposes that stock market prices fully reflect all information available and that, because of this, future stock prices cannot be forecasted. They follow a random walk (Malkiel, 1973). Fama (1970) reviews research on the EMH and found that there are weak, semi strong and strong forms of testing market efficiency. The weak forms of testing the EFM is when the information set used to test EMH is just historical stock prices, semi-strong tests are whether prices efficiently adjust to other information that is publically available and strong tests are concerned with whether given investors or groups have monopolistic access to information relevant for prices. He concludes that, with a few exceptions, the EMH stands up well (Fama, 1970, p. 383).

Others have critiqued the EMH and Shiller (2003) shows that these initial critiques started the behavioural finance paradigm. Some of the earlier critiques include Shiller (1981) who showed that stock prices exhibited excess volatility to be explained by dividend information. Also, Stiglitz (1981) critiqued the EMH because resource allocations may not be Pareto efficient. Additionally, De Bondt and Thaler (1985) argue that overreaction occurs in the stock markets prices. However, according to Lo (2008), the most enduring critique against the EMH comes from psychologists and behavioural economists who argue that the EMH is

based on counterfactual assumptions regarding human behaviour, that is, normative rationality.

Normative rationality, also referred to as *homo economicus*, is one assumption made by neo-classical economics which underlies standard finance theory (Ross, 2005). The *homo economicus* assumption received critique from Simon (1955, 1986). He introduced the theory of bounded rationality to incorporate restrictions of limited time, knowledge and computational abilities faced by decision makers. Bounded rationality adapts the *homo economicus* in neo-classical economics, by removing the assumptions that decision makers have perfect knowledge and unlimited processing capabilities. Simon's theory has been incorporated by research on the psychology of decision making which introduced heuristics and bias, risk preferences and framing effects to show how people deviate from the neo-classical economic model of normative rationality (Gilovich and Griffin, 2002).

Theoretical concepts and findings from decision making research have been incorporated into the behavioural finance paradigm. Where traditional finance attempts to model markets using the *homo economicus* assumption (Fama, 1970, Ross, 2005), behavioural finance creates models by utilising decision making theories. By incorporating bounded rationality into financial models, behavioural finance attempts to explain observed prices, market trading volume, and individual behaviour better than traditional finance models (Glaser et al., 2004, p. 531). Knowledge is developed within the behavioural finance paradigm using two basic approaches outlined in Figure 1:1 (Glaser et al., 2004). One approach involves taking decision making theory, normally from heuristic and bias research (Gilovich et al., 2002), then incorporating the theory into a model of market behaviour and

testing whether this model explains market behaviour better than traditional finance models. An example of this approach is Benartzi and Thaler (2001) who use the diversification heuristic ($1/n$) to explain investors portfolio choice in investment retirement plans. The other approach of behavioural finance begins with an observation of a market anomaly, and then an appropriate psychological theory to explain its existence is found. An example of this approach is offered by Shiller (2003) who outlines how behavioural finance research has observed high market volatility and subsequently used feedback models to better explain this anomaly.

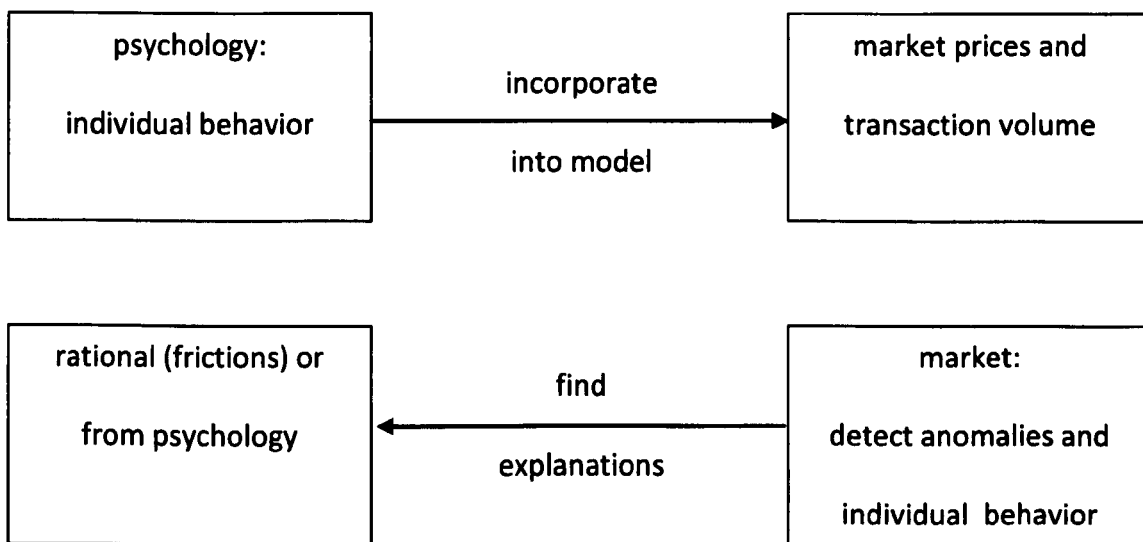


Figure 1:1: Two approaches of behavioural finance

Source: Glaser et al. (2004, p. 532)

A critique of the behavioural finance approaches is that there is not a direct two way test of the relationship between the psychological constructs and the behaviour they are used to predict. When a psychological theory is incorporated into a model or used to explain a market anomaly, there is little direct evidence about whether the psychological theory is

actually how market players behave or think. This thesis directly addresses this gap by focusing on a particular investment bias, the disposition effect, which is found in both market behaviour (Odean, 1998) and experimental settings (Weber and Camerer, 1998). It examines the relationships between this bias and key psychological theories using data from investors trading in real stock markets. It tests the extent to which psychological theories used to explain susceptibility to bias can predict the level of bias exhibited by stock market investors.

The disposition effect is a stock market investment bias where “investors sell winners too early and ride losers too long” (Shefrin and Statman, 1985, p. 778). This investment bias was selected because there is robust evidence of it occurring in both experimental (Chui, 2001, Summers and Duxbury, 2012, Weber and Camerer, 1998) and field based studies (Feng and Seasholes, 2005, Odean, 1998, Seru et al., 2010). Research on the disposition effect has moved from proving proof of concept (Odean, 1998, Shefrin and Statman, 1985) to explaining why some investors are more susceptible than others in exhibiting this bias (Shapira and Venezia, 2001). Field research investigating susceptibility to the disposition effect has focused on sophistication and experience as explanations of why some investors are more or less prone to this bias (Brown et al., 2006, Feng and Seasholes, 2005, Shapira and Venezia, 2001). However, there are two gaps in this literature. Firstly, there is no research involving UK individual investors and secondly, there is no research on the extent to which stop loss strategies inoculate against this bias. Thus, the first two research questions that this thesis addresses are:

Q1. To what extent do UK stock market investors exhibit the disposition effect?

Q2. To what extent do investor sophistication, investor experience and use of stop loss strategies reduce the disposition effect of UK stock market investors?

The second focus of this thesis is to show whether two psychological theories can explain susceptibility to decision bias in a real world setting. Firstly, I draw on dual process theory which distinguishes between two systems of cognitive processing, referred to as system 1 and system 2¹ (Epstein, 1994, Evans, 2003, Evans, 2008, Lieberman, 2003, Sloman, 2002, Stanovich and West, 2000). Similarities between dual process theory and Weber's (1947) rational behavioural can be drawn. Weber (1947) distinguishes between two types of rationality; substantive and formal. Formal rationality refers to behaviour which is logically calculated, efficient and objective whereas substantive rationality is based on personal devotion, piety and custom (Cockerham et al., 1993). Thus System 2 is similar to formal rationality and System 1 similar to substantive rationality. Where dual process theory deviates from Weber's rationality is that Weber focuses economic behaviour and dual process theory on cognitive processes. Dual process theory has evolved from a predominate psychological background (Frankish and Evans, 2009) and has recently been adopted by the heuristics and bias paradigm as an explanation of why bias occurs in decision making (Kahneman, 2003, Kahneman and Frederick, 2005). Heuristic judgements which lead to bias decision making are associated with system 1 cognition but system 2 cognition may intervene to correct bias (Kahneman, 2003). The contribution of this thesis is that it empirically examines the extent to which an investor's reliance on system 1 and system 2 cognition is related to the disposition effect.

¹ System 1 refers to cognition which is characterised as automatic, largely unconscious, and relatively undemanding of computational capacity. Thus, it conjoins properties of automaticity and heuristic processing (Stanovich and West, 2000, p. 658). System 2 refers to cognition which is characterised by controlled processing. System 2 encompasses the processes of analytic intelligence (Stanovich and West, 2000, p. 658).

The other psychological theory that this thesis empirically examines is the link between emotion regulation and decision making bias. Drawing on an emotion regulation model outlined by Gross (2002, Gross and Thompson, 2007), the thesis examines the extent to which two different emotion regulation strategies influence the disposition effect. The two emotion regulation strategies are reappraisal and expressive suppression. Reappraisal refers to regulating emotions by cognitively changing the meaning of an emotionally eliciting situation and expressive suppression refers to inhibiting emotional expressive behaviour (Gross and John, 2003). Research has found that reappraisal is more effective than expressive suppression at decreasing both physiological responses and the experience of negative emotion in psychological experiments (Gross, 2002, Richards and Gross, 2000). Also reappraisal is related to improved performance on work, via increased task focus, in retail and a call centre organisations and related to improved performance on decision making tasks involving social interactions and loss aversion (Wallace et al., 2009, Sokol-Hessner et al., 2009, van't Wout et al., 2010). Since several explanations of the disposition effect propose an affective cause, I examine whether more effective emotion regulation is associated with exhibiting the disposition effect to a lesser extent. This thesis contributes to the decision making literature by empirically testing whether reappraisal and expressive suppression emotion regulation are related to the disposition effect. The third research question this thesis addresses is:

Q.3 To what extent do individual differences in reliance on system 1 and system 2 cognition, and individual differences in the use of reappraisal and expressive suppression emotion regulation, relate to the disposition effect for UK stock market investors?

I have adopted an epistemology based upon logical positivism favouring a quantitative methodology and methods. This appears to be the most appropriate way of addressing the research questions and uncovering the key behavioural relationships explored in this thesis. The research methods involved collecting the trading records of investors from a UK brokerage firm. This data was filtered into roundtrip transactions where investors had bought and subsequently sold the same amount of stock. The trading data used for analysis consisted of 65,096 transactions that were made by 4,328 investors over the period from 04/07/2006 to 14/12/2009. I used survival analysis to measure the disposition effect and the influence of variables on susceptibility to it (Feng and Seasholes, 2005). Some dependent variables, such as proxies for sophistication and experience, were contained in the trading data and could be used for analysis. However, the remainder of the dependent variables were measured by inviting some of the investors to complete an online questionnaire. To measure individual differences in system 1 and system 2 cognition I used a short version of Rational Experiential Inventory (Norris and Epstein, 2009, Pacini and Epstein, 1999) and to measure individual differences in emotion regulation I used the Emotion Regulation Questionnaire (Gross and John, 2003). I also included questions pertaining to an investor's experience and self-rated expertise. Each investor was assigned a unique number and this number was also included on each investor's questionnaire. This allowed me to match the response to the questionnaire to the relevant investor's trading records. In total, there were 261 responses to the questionnaire that were matched to 4,193 roundtrip transactions and these were also used in the analysis.

1.2 Contributions to knowledge

The findings of this thesis contribute to what we know about the antecedents of the disposition effect and contribute more broadly to what we understand about the functioning of decision biases in real world settings. The thesis contributes evidence of the disposition effect in a new context (the UK stock market); a new definition of sophistication; and shows that experienced and sophisticated investors in the UK are less susceptible to this bias. An obvious method for counteracting the disposition effect is through the use of stop loss strategies which are automatic protocols to sell stocks when they reduce in value. This thesis extends current knowledge by showing that an investor can significantly reduce their propensity to suffer from the disposition effect through the use of stop loss strategies.

The second academic contribution of this thesis is to add knowledge about decision making behaviour. The findings support the dual process theory of decision making bias proposed by Kahneman and Frederick (2002, 2005) as they show that investors who report higher ability in system 1 cognition are more prone to the disposition effect. There is also evidence that investors who report higher preference towards system 2 cognitive processes are less susceptible to this bias. An inference of these findings is that system 1 cognitive processes are related to bias and that system 2 cognitive process can avert bias in an applied setting outside of the laboratory. In relation to emotion regulation, this thesis tentatively finds that reappraisal decreases the disposition effect. The reason why this finding is tentative is that reappraisal only influences the reluctance to trade losses and not the eagerness to trade gains. Also the influence of reappraisal on trading losses drops in significance when other variables are considered. In relation to expressive suppression, the

findings cannot support a relationship between it and the disposition effect. An inference of these findings is that they offer tentative support for the relevance of emotion regulation to decision making bias.

1.3 Structure of the thesis

The structure of the thesis is as follows. Chapter 2 introduces the explanations of the disposition effect and then reviews existing research on the disposition effect. It focuses on literature from real life settings and identifies the variables used to identify susceptibility to the disposition effect. The two main variables are sophistication and experience and a critical review of these two variables is presented. It identifies a gap in the literature surrounding the use of stop losses to inoculate against this bias. This chapter also presents research hypotheses for this thesis. It ends with a critique of sophistication and experience by arguing that they are limited in the extent to which they further understanding of susceptibility to the disposition effect.

Chapter 3 is a literature review of the psychological variables used in this thesis to explain susceptibility to the disposition effect. It begins with a review of experimental research that integrates psychological explanations of decision making bias with the disposition effect. It then reviews dual process theory and research on emotion regulation and explains how these could be used to explain susceptibility to the disposition effect. From this discussion, research hypotheses are proposed.

Chapter 4 is a discussion of the epistemology, ontology, methodology and methods of this research project. It begins by discussing the basic epistemological and ontological assumptions in business research as outlined by Bryman and Bell (2003). It critically reviews the methodologies used so far to research the disposition effect. It outlines that the methodology used in this thesis is the analysis of investors trading data and an online questionnaire. The method of analysing this data is survival analysis. The chapter ends with an explanation of how survival analysis is used to analyse trading data for the disposition effect.

Chapter 5 gives details about the data. It describes the collection of the trading records and how these were converted into a suitable format for analysis. It also outlines the stock price data that was downloaded from Datastream and how the online questionnaire data was collected. Finally, this chapter tests whether the data is suitable for survival analysis and provides descriptive statistics about the data.

Chapter 6 presents the findings for susceptibility to the disposition effect based on demographic variables. By using the term 'demographic variables', I refer to the variables which are used to measure investor sophistication, investor experience and use of stop loss strategies. In this chapter I show that sophistication, experience and stop loss strategies all reduce the disposition effect. The final section of the chapter estimates the amount of variance in the disposition effect which is explained by these variables.

Chapter 7 presents the findings for susceptibility to the disposition effect based on the individual differences in both system 1 & system 2 cognition and reappraisal & expressive

suppression emotion regulation. These results show that investors who report having higher ability in system 1 cognition are more prone to disposition effect. There is also some evidence which shows that investors who report higher preference for system 2 cognition are less susceptible to this bias. There is tentative evidence showing that investors higher in reappraisal exhibit the disposition effect to a lesser extent. The final section of the chapter estimates the amount of variance in disposition effect explained by the psychological variables.

Chapter 8 summarises the main findings of thesis and Chapter 9 outlines the academic contributions of this thesis. Chapter 9 also discuss some the limitations of the research, areas of future research and practical implications of the findings.

Chapter 2. Literature review of the disposition effect

The purpose of this chapter is to critically review literature on the disposition effect and present the research hypotheses. This chapter is divided into three sections. The first defines the disposition effect and critically reviews the explanations of what causes it. The second section reviews research that investigated investor differences in susceptibility to the disposition effect. This review shows that sophistication and experience are the two major independent variables adopted so far in disposition effect research. A review of research on these variables is given and, from this, hypotheses are outlined for this thesis. The third section is a critique of the sophistication and experience arguments. It identifies a gap in the literature which is that susceptibility to the disposition effect has not been researched using a psychological perspective.

2.1 Disposition effect

Shefrin and Statman (1985) coined the term 'disposition effect' as a label for an investment bias where investors hold investments longer if they have depreciated in value than when they have appreciated in value. In laymen terms, investors sell winners too early and ride losers too long (Shefrin and Statman, 1985, p. 778). The disposition effect is similar to a reluctance to accept losses and an eagerness to sell gains. This bias has proved costly for investors because the stocks they sell at a gain outperform the stocks they continue to hold at a loss (Odean, 1998). The disposition effect is also associated with poor investment performance (Seru et al., 2010, Talpsepp, 2010). Why do investors do this? Shefrin and

Statman (1985) provide three explanations for why the disposition effect occurs; prospect theory (Kahneman and Tversky, 1979), mental accounting (Thaler, 1985), seeking pride and avoiding regret. A critical review of each explanation is provided next.

2.1.1 Prospect theory

Prospect theory is the explanation which is most frequently cited as a cause of the disposition effect (Brown et al., 2006, Chen et al., 2007, Dhar and Zhu, 2006, Feng and Seasholes, 2005, Odean, 1998, Shapira and Venezia, 2001). Prospect theory (Kahneman and Tversky, 1979) is an amendment to the expected utility theory proposed by Bernoulli (1954). Kahneman and Tversky's (1979) prospect theory differs to expected utility theory as it compares changes in value relative to gains and losses around a reference point, rather than total wealth used in expected utility theory. Also in expected utility each weighting is multiplied by its probability. Prospect theory differs from this as it uses decision weights which are not probability outcomes. Kahneman and Tversky (1979) find that these weights are not linear, making the value function is 'S' shaped. That is, it is concave in the area of losses and convex in the area of gains and the function is steeper for losses than for gains, which is referred to as loss aversion (Soman, 2004). Please refer to Figure 2:1 for an outline of the prospect theory utility function.

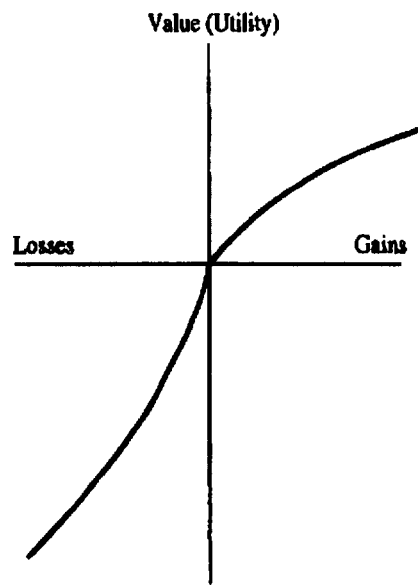


Figure 2:1 Prospect theory value function

The relationship between prospect theory and the disposition effect in share market investment is articulated by Odean (1998, p. 1777) who states:

... suppose an investor purchases a stock that she believes to have an expected return high enough to justify its risk. If the stock appreciates and the investor continues to use the purchase price as a reference point, the stock price will then be in a more concave, more risk-averse, part of the investor's value function. It may be that the stock's expected return continues to justify its risk. However, if the investor somewhat lowers her expectation of the stock's return, she will be likely to sell the stock. What if, instead of appreciating, the stock declines? Then its price is in the convex, risk-seeking, part of the value function. Here the investor will continue to hold the stock even if its expected return falls lower than would have been necessary for her to justify its original purchase. Thus the investor's belief about expected

return must fall further to motivate the sale of a stock that has already declined than one that has appreciated.

According to a prospect theory explanation, the disposition effect occurs regardless of an investor's risk preferences. The disposition effect occurs because investors have a different risk profile towards gains than they do losses. Thus a risk seeking investor is less risk seeking for gains than she is for losses, and a risk averse investor is more risk seeking for losses than she is for gains. Research on the disposition effect has assumed that prospect theory was the cause of this bias without empirically testing this assumption (Brown et al., 2006, Chen et al., 2007, Dhar and Zhu, 2006, Feng and Seasholes, 2005, Odean, 1998, Shapira and Venezia, 2001). More recently, this assumption has been questioned in both theoretical (Hens and Vlcek, 2005, Zuchel, 2001, Barberis and Xiong, 2009) and empirical research (Lehenkari, 2012, Kaustia, 2010, Summers and Duxbury, 2012). This research argues that prospect theory alone cannot explain the disposition effect and a review of their research is outlined next.

Summers and Duxbury (2012) show that active choice is key to the disposition effect. In an experimental design, they found that participants only exhibited the disposition effect when they made the decision to buy a stock and not when they inherited it. Thus, prospect theory alone cannot explain the disposition effect because experiencing gains and losses was not enough to induce it. The participants had to make the decision to buy and then experience a gain or a loss for the disposition effect to occur. This could relate to differences between risk and uncertainty. Knight (1921) distinguishes between risk and uncertainty by stating that risk is measurable whereas uncertainty cannot be measured. In this situation, the

participants can measure their risk after they have purchased a stock because the purchase price acts as a fixed reference point. If the participant inherits the stock, uncertainty exists because a clear reference point is not available and cannot be used to make calculations. However, Summers and Duxbury (2012) suggest that emotional aspects, regret and elation, are the key drivers of the disposition effect. Lehenkari (2012) found similar results to Summers and Duxbury (2012) for investors in Finnish stock market. Lehenkari (2012) separated the investors who inherited stocks from investors who purchased stocks themselves. He found that the size of the disposition effect was larger in the latter group of investors, than in the former. Finally, Kaustia (2010) investigated whether the selling gains or losses matches the 'S' shaped curve of prospect theory. Whilst he found that investors are more reluctant to sell losses than gains, he also found that the propensity to sell a loss is the same whether or not the loss is large or small in percentage terms. For gains, the propensity to sell increases or remains constant over a wide range of gains. He concludes that the disposition effect does not match the 'S' shaped curve of prospect theory.

Whilst prospect theory is commonly cited as the underlying cause of the disposition effect recent research presented by Summers and Duxbury (2012), Lehenkari (2012) and Kaustia (2010) suggest that this assumption may not be correct. Thus, the alternative explanations proposed by Shefrin and Statman (1985) are outlined next.

2.1.2 Mental accounting

Mental accounting is another theoretical explanation of the disposition effect. Thaler (1985) originally introduced mental accounting as a substitute to the standard economic

theory of consumer behaviour. He argues that consumers may segregate gains, integrate losses, cancel losses against gains and adopt a 'silver lining' principle. According to Shefrin & Statman (1985, p. 780) the relationship between mental accounting and the disposition effect is that investors segregate their investments into separate mental accounts and then apply prospect theoretic decision rules to each account, ignoring possible interactions. Each stock market investment decision is treated individually rather than concentrating on portfolio performance and this leads to the disposition effect. Mental accounting can be related to a decision making bias, called narrow framing (or narrow bracketing). Narrow framing is when a series of decisions are considered individually and is opposed to broad framing where a series of decisions are considered collectively (Kahneman and Lovallo, 1993). Research has shown that people do not broad frame when it is feasible to do so (Read et al., 1999, Tversky and Kahneman, 1986), supporting the mental accounting argument of the disposition effect.

Whether or not investors treat each share individually has not been empirically researched. Therefore, it is difficult to ascertain whether investors use mental accounting when making investment decisions. A secondary aspect of mental accounting, hedonic editing, has been researched empirically. Hedonic editing is when people maintain states of pleasurable feelings over time by combining negative events and separating good events (Thaler, 1985, Thaler, 1999, Thaler and Johnson, 1990). In relation to stock market investment it is argued that investors will do the following to maintain hedonic tone: integrate losses; segregate gains; integrate smaller losses with larger gains; and segregate small gains from larger losses, provided that the absolute value of the gain is significantly smaller than the absolute value of the loss (Lehenkari, 2009). Evidence of hedonic editing in stock market investment

is inconsistent. Lim (2006) found that investors combined the selling losses into one day and separated the selling gains over several days. Furthermore, Kumar and Lim (2008) found that hedonic editing behaviour is significantly related to the disposition effect. However, in a different study, Lehenkari (2009) found no evidence of the behaviour identified by Lim (2006). Overall, the evidence that mental accounting bears relevance to the disposition effect is inconsistent and indirect.

2.1.3 Regret and pride

Shefrin and Statman (1985) outline that investors' pride seeking and regret avoiding behaviour is another cause of the disposition effect. Shefrin and Statman (1985, p. 781) define regret as an emotional feeling associated with the ex post knowledge that a different past decision would have fared better than the one chosen. They define pride as the positive counterpart to regret. According to Shefrin and Statman (1985) selling a stock at a loss induces regret, closing at a gain induces pride and investors exhibit the disposition effect because they seek pride and avoid regret. However, Shefrin and Statman's (1985) argument that regret and pride are symmetrical may be too simplistic. For example, it is possible for an investor to feel regret from selling a gain too early or holding a loss too long and then learn from this emotion to change future behaviour. In this example regret would be reducing the disposition.

Summers and Duxbury's (2012) research suggests that regret and elation are the major influences on what causes the disposition effect. They found that participants only exhibited the disposition effect when they purchased the stock. Having purchased the stock,

participants experienced regret when the stock decreased in value, and exhibited the disposition effect. If the stock was inherited by the participant and the stock decreased in value, participants experienced disappointment and did not exhibit the disposition effect. They also observed higher levels of self reported regret for those participants who purchased stock and then lost money, than those participants who inherited the stock and lost money. In relation to gains, they found that if the participant inherited or purchased the asset, then they experienced elation and were likely to sell the winner. Similarly, Lehenkari (2012) found that Finnish investors were quicker to sell losses if they inherited the stock rather than purchasing it for themselves.

The regret and pride seeking explanation of the disposition effect (Shefrin and Statman, 1985), the hedonic editing hypothesis (Kumar and Lim, 2008) and Summers and Duxbury's (2012) research locate the reason why the disposition effect occurs within the larger debate about emotions in decision making (Damasio, 1994, Loewenstein and Lerner, 2003, Finucane et al., 2000). Neuropsychological research has found that emotions play a central role in decision making (Damasio, 1994) and these findings are being incorporated into theories about decision making bias. Loewenstein et al. (2001) propose the 'risk-as-feelings' hypothesis to show that emotional reactions diverge from cognitive assessments of risk and often drive behaviour. Similarly, Finucane et al (2000) propose the affect heuristic suggesting that risk estimates are inherently linked with affective appraisals. These theories of decision making propose that emotions and decisions involving risk are intertwined and can also explain why the disposition effect occurs. That is, when an investor is presented with information about a stock trading at a loss, the emotion associated with this (e.g.

regret) is driving the decision to avoid selling it. Likewise, the emotion associated with a stock trading at a gain (e.g. elation) is influencing the decision to sell it.

This section has defined what is meant by the disposition effect and reviewed the theoretical causes of its existence. It outlined the original causes of the disposition effect as stated by Shefrin and Statman (1985) and proceeded to critique these theories. Whilst prospect theory is commonly used to explain why the disposition effect occurs, this reasoning is now being questioned (Kaustia, 2010, Lehenkari, 2012, Summers and Duxbury, 2012). The review showed that the mental accounting and the regret and pride explanations have more validity. Mental accounting can be related to a psychological concept called narrow framing for which evidence exists. Also the hedonic editing hypothesis and the regret and pride explanation can be related to emotions in decision making. This suggests that the cause of the disposition effect may be emotionally driven (Summers and Duxbury, 2012). However, research that investigates investor susceptibility to the disposition effect has not incorporated these theories. The next section of this chapter reviews the literature on investor susceptibility to the disposition effect. It outlines the variables that are associated with investor susceptibility to the disposition effect and on the basis of this review hypotheses for this thesis are generated.

2.2 Susceptibility to the disposition effect

There is evidence that the disposition effect occurs in many countries around the world (refer to appendix 1 for a literature review outlining the countries researched and a

summary of the main findings). Evidence of the disposition effect has been found for the following countries: USA (Odean, 1998), China (Chen et al., 2007, Feng and Seasholes, 2005), Finland (Grinblatt and Keloharju, 2001, Lehenkari and Perttunen, 2004), Australia (Brown et al., 2006), Israel (Shapira and Venezia, 2001), Japan (Bremer and Kato, 1996), France (Boolell-Gunesh et al., 2009), Estonia (Talpsepp, 2010) Portugal (Leal et al., 2010) and Taiwan (Barber et al., 2007, Shu et al., 2005). One country which has not been researched yet is the UK. Whilst the disposition effect occurs in many countries, you cannot assume that UK investors are equally prone to this bias because comparisons between countries are difficult to make due to different institutional and cultural contexts. This thesis assesses the level of disposition effect exhibited by UK investors and I hypothesise that investors in the UK will be susceptible to this bias. The first hypothesis is:

H1: In aggregate, investors in the UK will exhibit the disposition effect

Whilst the disposition effect is a robust finding in prior research, investors vary in the extent to which they exhibit this bias. Shapira and Venezia (2001) found that one in five investors do not show a disposition effect and Weber and Welfens (2008) found that 35% of investors do not. The focus of disposition effect research has turned to identifying individual differences which explain why some investors are less prone to this bias than others. The two variables that have been extensively researched in relation to susceptibility to the disposition effect are investor sophistication and experience (Brown et al., 2006, Chen et al., 2007, Dhar and Zhu, 2006, Grinblatt and Keloharju, 2001, Feng and Seasholes, 2005, Shumway and Wu, 2006, Shapira and Venezia, 2001). The following subsection reviews literature on sophistication and proposes a hypothesis based on this review. Then the next subsection

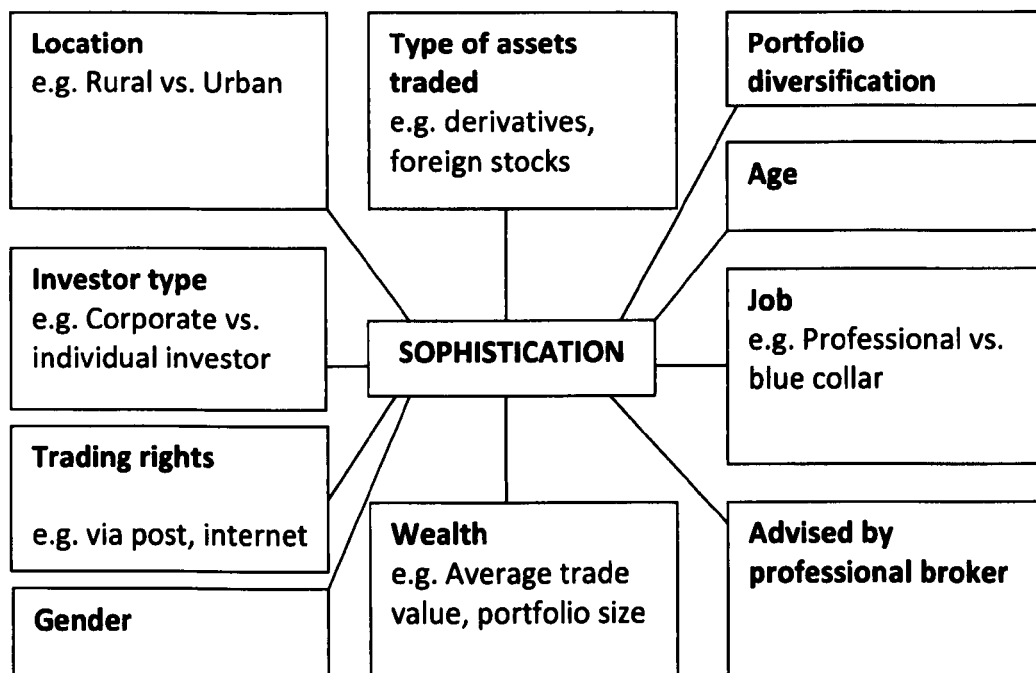
reviews literature on experience and presents hypotheses accordingly. In the last subsection a new variable, stop losses strategies, is introduced and this has not been researched in relation to the disposition effect.

2.2.1 Sophistication

Before reviewing literature which shows that investor sophistication decreases the disposition effect it is necessary to define sophistication. Offering a clear definition of sophistication is difficult because literature on the disposition effect has never defined sophistication. Furthermore, the literature does not offer a clear explanation of why sophisticated investors are less likely to exhibit the disposition effect. Accounting and finance research has investigated sophistication on the premises that institutional investors are more sophisticated than other investors (Utama and Cready, 1997, Walther, 1997). However, as will be discussed further below, this distinction of sophistication may not be appropriate for disposition effect research. Instead a definition of sophistication is created for the use of this thesis. The Oxford English Dictionary (1989) defines sophistication as “the quality or fact of being sophisticated; esp.(a) worldly wisdom or experience; subtlety, discrimination, refinement;(b) knowledge, expertise, in some technical subject.” The latter part of this definition is relevant to investor sophistication because the first part of the definition, experience, is researched independently in disposition effect literature (Feng and Seasholes, 2005, Seru et al., 2010). Sophistication should pertain to an investor’s technical knowledge and I argue that an investor’s knowledge of risk and attitude towards risk, in particular, has relevance for the disposition effect.

Another ambiguity with sophistication in disposition effect research is that the variable is measured indirectly through proxies. An overview of the proxies used to measure sophistication is presented in Figure 2:2. The ambiguity of sophistication increases because the proxies used are inconsistent and because sophistication was never defined. The review below utilises the aforementioned definition of sophistication to assess the validity of each proxy for this research.

Figure 2:2 Proxies used to measure sophistication



One proxy for sophistication adopted in disposition effect research is based on investor type. Grinblatt and Keloharju (2001) analysed data from the Finnish share market and investigated susceptibility to the disposition effect by classifying investors into types. The types of investors in Grinblatt and Keloharju's (2001) research are non financial corporations, financial and insurance institutions, general government, non-profit institutions, households and foreigners. They found that households, government, and non-

profit institutions are more predisposed to the disposition effect than non-financial corporations, finance and insurance institutions. They concluded that the latter group of investors were less prone to the disposition effect because they were more sophisticated than the former group of investors. Similarly, Brown et al. (2006) investigated the disposition effect of different types of investors for initial public offerings on the Australian stock market. The types of investors in their research are nominee companies, insurance companies, superannuation companies, government, incorporated companies, individuals and foreign investors. They found that insurance companies and nominee companies suffer less from the disposition effect than individual investors. However, their results also showed that insurance companies and nominee companies still exhibited the disposition effect and that incorporated companies have similar levels of disposition effect to individual investors. They suggest that investor type is a poor proxy for investor sophistication (Brown et al., 2006, p. 60). Despite this result, subsequent research compared individual investors to corporate investors and found that individual investors are more susceptible to the disposition effect (Chen et al., 2007, Shumway and Wu, 2006).

Research on the disposition effect has shown that corporate investors exhibit less disposition effect than individual investors. However, these findings do not necessarily imply that sophistication reduces the disposition effect. It is possible that the corporation's trading rules or procedures reduce susceptibility to the disposition effect rather than the corporate investor's level of sophistication (Shefrin and Statman, 1985). Furthermore, research has found that professional traders and day traders still exhibit the disposition effect (Coval and Shumway, 2005, Frino et al., 2004, Garvey and Murphy, 2004, Garvey et al., 2007, Haigh and List, 2005, Locke and Mann, 2005). A key difference between traders

and individual investors is that traders have a shorter duration between buying and selling an investment product. Due to this, the methodology applied to measure the disposition effect for traders (Garvey and Murphy, 2004) differs to the methodology used for individual investors (Feng and Seasholes, 2005, Odean, 1998). The literature which has investigated investor sophistication by comparing individual investors to corporate investors has generally adopted a methodology suited to identifying the disposition effect in individual investors. This could also cause the disparity in the level of disposition effect observed between corporate and individual investors. In sum, research on sophistication and the disposition effect based on a distinction between corporate and individual investors has robust findings. However, this literature does not clearly demonstrate that it is specifically sophistication that is reducing susceptibility to this bias.

A better method of testing the relationship between sophistication and the disposition effect is to distinguish levels of sophistication amongst individual investors. Shapira and Venezia (2001) offered one method of doing this as they classified investors by the level of advice they received. An investor was deemed sophisticated if they received professional advice when making their decisions. They found that the disposition effect was stronger for independent investors than for those who were professionally advised, showing that sophistication reduces the disposition effect. Seru et al. (2010) classified sophisticated investors by the products they traded and deemed investors as sophisticated if they were trading options. Seru et al. (2010) found that these investors were less likely to exhibit the disposition effect. Boolell-Gunesh et al. (2009) used a similar method of classifying sophisticated investors. They deemed investors as sophisticated if they traded derivatives, diversified internationally and sold short in the market. Boolell-Gunesh et al. (2009) found

that sophistication attenuated, but did not eliminate, the disposition effect. Trading more complex financial products such as derivatives or short selling is a good measure of sophistication as it requires more knowledge about risks and types of complex financial products.

Another approach to measuring sophistication is via wealth proxies. This assumes that wealthier people have more education with regards to financial products and/or that being wealthy endows investors with an ability to gain expertise in financial products. One method of measuring wealth is to take the average value of an investors trades on the premise that investors who instigate higher value trades are likely to be more sophisticated (Brown et al., 2006, p. 60). Brown et al. (2006) and also Shumway and Wu (2006) found that investors with larger trade values are less prone to the disposition effect. Dhar and Zhu (2006) measured sophistication by the investor's income and job classification (as either professional or non-professional) and found that that investors with professional jobs and higher income exhibited less disposition effect. Lastly, Seru et al. (2010) used portfolio value and average value of trades and found that these proxies of sophistication decrease the disposition effect.

Research that uses wealth as a proxy for sophistication has consistently shown that wealth proxies are associated with a decrease in the disposition effect. However, a weakness of this approach is that the various measures of wealth are noisy, with wealth never being precisely measured. If average trade value or portfolio value is adopted, there are certain factors which will reduce the validity of this measure. For example there are different levels of diversification amongst investors or the investor may have invested through another

brokerage firm or in other kinds of investments (e.g. property). Also the size of the portfolio may be correlated with the extent to which an investor diversifies. Likewise, when wealth is measured via income, it is possible that an investor who is younger may have high income levels but accumulated low amounts of wealth. An additional critique pertains to the underlying arguments behind using wealth as a proxy for sophistication. This assumes that wealthier people have more education with regards to financial products. Whilst this seems logical because within the general population education is linked to levels of wealth (Callaghan, 2007), it may be contentious because investors are a wealthy subset of the population. Differentiating by wealth amongst investors may not distinguish different levels of education as well as it would for the general population. For these reasons, average trade value will not be used as a proxy for sophistication but it will be included as a control variable for other findings.

Feng and Seasholes (2005) used a combination of proxies for sophistication in their research on the disposition effect for Chinese investors. They found that sophistication decreases the disposition effect and their measure of sophistication included trading rights, initial portfolio diversification, gender and age. Trading rights refers to the different ways in which an investor can place orders (e.g. via post or internet) and to be entitled to use each method investors had to apply to their brokerage firm. Whilst trading rights seem linked to sophistication, this measure cannot be incorporated into this study because there are no trading rights in the UK. Feng and Seasholes (2005) defined a portfolio as diversified if an investor purchased two or more stocks when they first started trading. Portfolio diversification is also related to sophistication but cannot be incorporated into this research because portfolio information was not available in the data set obtained.

Feng and Seasholes (2005) and Shu et al. (2005) argue that men are more likely to realise losses than women. However, the adjusted R^2 ratio for Shu et al. (2005) is 0.03 in a sample which contained 51.1% women, suggesting that gender has a minor influence.

Furthermore, in a subsequent publication using the same data, Feng and Seasholes (2008) found that gender did not influence other trading biases. Finally, Barber et al. (2007) and Talpsepp (2010) found no significant difference in the amount of disposition effect observed by men and women. On a conceptual level, the relationship between gender and sophistication is questionable because there is no inherent reason why men should be more sophisticated than women. Also, there may be issues with the validity of this variable because one of a couple may open an investment account in their partner's name for tax reasons. Thus, even though the account is in one person's name, the decisions may be their partner. Therefore, this thesis does not use gender as a proxy for sophistication but includes it as a control variable.

In relation to age, Feng and Seasholes (2005) argued that this variable was relative to economic reforms in China. They posit that the oldest investors who had been educated under the economic reforms were more likely to be more sophisticated. In their research this relates to the 25-35 age group of investor and their results showed that this age group was least prone to the disposition effect. Chen et al. (2007) also measured sophistication by using the investor's age relative to the economic reforms in China. For their research the age group which was least sophisticated was the 40 year old investor. Similar to Feng and Seasholes (2005), they found that investors aged 40 were most prone to the disposition effect. However, contrary to Feng and Seasholes (2005), they also found that both younger

and older investors were less likely to exhibit the disposition effect. Finally, Dhar and Zhu (2006) investigated US investors and found that older investors were less susceptible to the disposition effect. In relation to this thesis, the use of age as a proxy for sophistication is not applicable for UK investors because the UK has not undergone the same economic reforms as China. Yet, age can be related to experience and this will be explored in the subsection on experience.

Finally, Chen et al. (2007) used the location of the investor as a proxy to measure investor sophistication in their research on the disposition effect for Chinese investors. They found that investors who lived in rural locations were more prone to the disposition effect. The use of location as a proxy for sophistication is based on rural investors not obtaining the same level of education as urban investors. Whilst this does apply to the Chinese context, it is not relevant for developed countries, such as the UK, where access to education is equal nationwide. For this reason, location is not adopted as a proxy for sophistication.

In sum, the Oxford Dictionary characterised sophistication with having some technical knowledge. The review above showed that proxies for sophistication based on investor type, wealth, age, location and gender are not valid based on this definition. However, proxies based on the trading of complex products, portfolio diversification and trading rights have more merit. It still remains unclear what specific technical knowledge is of most relevance to the reducing the disposition effect. For example, it could be mathematical knowledge as it allows a comprehension of the size of gains or losses. Or it could be knowledge of technical analysis, where investors use stock price charts to make investment decisions, as this endows an investor with a belief that they can predict future market

prices. However, I propose that the aspect of technical knowledge which is of most relevance to reducing the disposition effect is an understanding of the risks involved with holding investment products and a positive attitude towards these risks. An investor who has a strong understanding of these risks is aware of the potential gains and losses they could experience and is equipped with the knowledge to react accordingly. Therefore, a proxy for sophistication should be able to distinguish investors based on their knowledge of risk.

A method of classifying investors as sophisticated is based on the whether or not they trade more complex financial products. In the UK there is a requirement by the Financial Services Authority (2009), that any investor who wants to trade complex financial products must pass an appropriateness assessment test. This appropriateness assessment involves informing investors about the risks they face and also having them report their knowledge of the risks involved with certain products (an example of the questions in a appropriate assessment are included in appendix 2). If an investor passes this appropriateness assessment it shows they have a greater understanding of risks. Thus, a good proxy for identifying sophisticated investors is based on the whether or not they trade more complex financial products. A comparison between the level of disposition effect exhibited by these investors and others will test whether sophistication reduces the disposition effect. Thus, it is hypothesised that:

H2: Investors who trade more complex financial products will exhibit the disposition effect to a lesser extent

2.2.2 Experience

The purpose of this subsection is to review the literature that investigates the relationship between experience and susceptibility to the disposition effect. Before reviewing the literature it is necessary to discuss the relationship between sophistication and experience because the two concepts could be related. Research which has investigated both of these concepts simultaneously has treated the concepts separately (Feng and Seasholes, 2005, Seru et al., 2010). This thesis will also investigate the two concepts separately because the definition of sophistication used pertains specifically to knowledge of investment products. With this definition of sophistication, there is not necessarily a relationship between sophistication and experience. It is possible for an investor to gain experience but not learn more about the technical side of investment. However, if the definition of sophistication included other forms of knowledge, such as self knowledge or knowledge of bull and bear markets, the relationship between the concepts would be stronger. As the definition of sophistication is constricted, I treat the two concepts separately. This thesis uses sophistication to encapsulate technical knowledge of risk and experience to encapsulate other forms of knowledge gained overtime.

One proxy for measuring experience is an investor's age. An investor's age will have a correlation with their investment experience and will also encapsulate other forms of experience relevant to investment. For example, older investors may have more experience with investing and, in particular, experience with both bull and bear markets. As mentioned above research on the disposition effect has not specifically treated age as a proxy of experience, but as research has used it as a proxy for the sophistication level of Chinese investors. Also, Dhar and Zhu (2006) found that older investors were less susceptible to the

disposition effect. Thus, I predict that older investors in the UK will be less susceptible to the disposition effect. However, age may also be correlated with wealth because older investors tend to have saved for retirement and accumulated more wealth. Thus, it is important to investigate the relationship between age and the disposition effect whilst controlling for average trade value.

There are two other ways of measuring investment experience: the cumulative number of trades executed by an investor or the length of time investing. Of the two methods, research has found that the cumulative number of trades has more influence on decreasing the disposition effect. Feng and Seasholes (2005) assessed experience by the number of trades an investor made after opening an account and found that as experience increased the disposition effect decreased. Chen et al. (2007) used the number of years an account was open and found that this measure did not significantly increase or decrease the disposition effect. Finally, Seru et al. (2010) investigated directly whether cumulative trades or years of experience is better at decreasing the disposition effect. They found that “the disposition effect declines as investors become more experienced, suggesting that investors learn by trading. Importantly, cumulative trades is a better measure of trading experience than the number of years that an investor has traded; our evidence that years of experience matters is relatively weak” (Seru et al., 2010, p. 733). However, Seru et al. (2010) reached this conclusion after investor attrition was considered because many investors who were high in the disposition effect stopped investing. Without considering attrition rates, they found that both cumulative trades and years of trading experienced reduced the disposition effect.

In summary, there are three relevant proxies for investment experience. These are age, years of investment and cumulative trading frequency. I hypothesise that all are relevant to reducing the disposition effect and all three will be related to each other. Thus, the hypotheses pertaining to investment experience are as follows:

H3: Older investors will exhibit the disposition effect to a lesser extent

H4: Older investors will exhibit the disposition effect to a lesser extent whilst controlling for average trade value

H5: Investors with more years of investment experience will exhibit the disposition effect to a lesser extent

H6: Investors with more cumulative trades will exhibit the disposition effect to a lesser extent

2.2.3 Stop loss strategies

One of the easiest ways for an investor to counteract the disposition effect is through an effective stop loss strategy. Stop losses are free for investors, easily implemented, and require only a small amount of knowledge to use. Thus, stop loss strategies are a separate variable to sophistication and experience. Despite this, there is very little research on investors' use of stop loss strategies to inoculate against the disposition effect (Lei and Li, 2009). This subsection reviews literature on stop loss strategies and hypothesises how their use will influence the disposition effect. It begins by describing automatic trading strategies and reviewing research on limit orders. It then contrasts stop loss strategies to limit orders

and argues that their use could decrease the disposition effect. It then reviews literature on stop losses from portfolio insurance literature and offers a research hypothesis.

I use the term automatic trading strategies to refer to the electronic tools that an investor can use to preset the trading of stocks in accordance with (possible) future changes in a stock's price. Automatic trading strategies are different to market orders which are executed at the current market price. An automatic trading strategy is set and then activated only by changes in a stock's price. Linnainmaa (2010) investigates a type of automatic trading strategy referred to as limit orders. Buy limit orders are always set below the stock's price and sell limit orders are always set above the stock's price. Thus, when the stock's price increases, sell limit orders are triggered and when the stock's price decreases, buy limit orders are triggered. Linnainmaa (2010) finds that the use of limit orders increases the disposition effect because investors are selling stocks as the price increases and are, therefore, more likely to sell winners. Sell limit orders are not triggered as the price decreases making it appear that investors are holding losers longer. A critique of Linnainmaa's (2010) research is that it does include automatic trading strategies where orders to sell stock are placed below the current price. I refer to these automatic trading activities as stop loss strategies and they could have a significant influence at inoculating against the disposition effect.

There are two types of stop losses used by individual investors: an ordinary stop loss and a tracking stop loss. An ordinary stop loss involves setting an order to sell if a stock's price drops to a certain level. This type of stop loss is always set below the current price of the stock and is activated by a decrease in the stock price. A tracking stop loss is slightly more

complicated because the investor chooses an *amount* of decrease in the stock's price. After being set, the tracking stop loss tracks the price of a stock as it increases, recording its highest price (the highest price starts at the price of the stock when the tracking stop loss is set). A sale is triggered if the stock's price drops from the highest price by the *amount* predetermined by the investor (Lei and Li, 2009). Thus, a tracking stop loss also sells stock after a decrease in the stock price. Use of stop losses is optional for an investor and the level that they are set at is determined by the investor, not by the brokerage firm. Both stop losses can be used to sell stocks at a gain or a loss. An ordinary stop loss is more suitable to counteract the reluctance to sell stocks at a loss because the investor has a predetermined loss exit-strategy. A tracking stop loss is more suitable to counteract the eagerness to sell stocks at a gain because the investor can delay selling, then wait to see if the stock's price continues to increase.

There is a gap in the literature relating to investor use of stop loss strategies to inoculate against the disposition effect. Research on stop loss strategies has come from literature on portfolio insurance (Rubinstein, 1985). This research has assumed that investors would adopt a stop loss strategy that involves selling their portfolio, then reinvesting it in a risk free asset in order to maintain an equivalent portfolio level. Thus, the focus of this research is whether such strategies are optimal for portfolio returns (Dybvig, 1988, Gollier, 1997).

More recent research on stop loss strategies has used computer simulated trading to show whether investors should or should not utilise them (Annaert et al., 2009, Lei and Li, 2009, Dichtl and Drobetz, 2011). Annaert et al. (2009) compare a stop loss strategy to a buy and hold strategy and find that although a stop loss strategy has less return than a buy and hold strategy, it also is less risky. Similarly, Lei and Li (2009) find that a stop loss strategy has

similar levels of return and less risk, when compared to a buy and hold strategy. Dichtl and Drobetz (2011) assess the value of stop loss strategies for an investor who invests according to prospect theory. They argue that stop loss strategies are appealing to investors given this condition. Overall, this literature has not investigated the actual use of stop losses by investors in relation to inoculating against the disposition effect. This thesis addresses this gap and I predict that that stop loss strategies are useful at counteracting this bias.

Therefore, the following is hypothesised:

H7: Investors who use stop losses will exhibit the disposition effect to a lesser extent

The section above reviewed research on individual investor susceptibility to the disposition effect. The arguments outlined by this literature are that investor sophistication and experience reduce susceptibility to this bias. However, there is no clear definition of investor sophistication. A definition was created which links investor sophistication to substantial knowledge of financial products. Using this definition as a basis, a critical review of the different proxies for sophistication was outlined. It was argued that the best proxy for measuring sophistication was to identify those investors who trade complex products. Investors' experience could be measured using age, cumulative trading frequency and years of experience, each of which were applicable to this variable. Finally, a gap in the literature on susceptibility to the disposition effect is there is no research on the extent to which stop losses strategies inoculate against this bias.

2.2.4 Critique of sophistication and experience

The previous two sections reviewed literature on the disposition effect. The first reviewed the explanations of why the bias occurs and the second critically reviewed research on investor susceptibility to disposition effect. The arguments reviewed in each of the sections are quite different, with the first drawing on psychological literature and the second proposing sophistication and experience arguments. The purpose of this section is to expand on this difference and identify a gap in the literature that this thesis addresses.

A critique of the sophistication and experience arguments is that they are moving away from the psychological constructs used to explain the disposition effect. Shefrin & Statman (1985) utilised prospect theory (Kahneman and Tversky, 1979), mental accounting (Thaler, 1980) and regret and pride to explain why investors trade in this manner. This reasoning suggests that the disposition effect is a psychological decision making bias. Despite these foundations, literature on the disposition effect has pursued sophistication (knowledge) and experience as reasons for explaining why an investor is less susceptible to this bias. There is a mismatch between explanations of what causes the bias and research on what makes an investor more or less prone to exhibiting it. Furthermore, recent empirical tests which examined the causes of the disposition effect have found that prospect theory was not sufficient to explain the bias (Kaustia, 2010, Lehenkari, 2012, Summers and Duxbury, 2012). This illustrates that a gap in the literature exists. This gap is that there is no research which has used psychological explanations of decision making bias to predict susceptibility of individual investors to the disposition effect.

An additional critique of the sophistication and experience arguments is that they are limited in the extent to which they contribute to our understanding of susceptibility to the

disposition effect. Whilst a relationship has been found between the variables, this research cannot explain why this relationship occurs. The research to date begs the question; what has a sophisticated and experienced investor learnt to overcome susceptibility to this bias? The sophistication and experience arguments cannot answer this question and herein lays another gap in the literature. Research has not attempted to delve deeper into susceptibility to the disposition effect to understand what is related to this decision making bias. This thesis offers a method of addressing these critiques. It utilises psychological theories to explain decision making bias and researches the link between them and the disposition effect of individual investors. The purpose of the next chapter is to review psychological literature and propose research hypotheses based on this.

2.3 Conclusion

This chapter consisted of three sections. The first critically reviewed the theoretical explanations of what causes the disposition effect. Prospect theory (Kahneman and Tversky, 1979), mental accounting (Thaler, 1980) and regret and pride are used to explain why investors trade in this manner. The prospect theory explanation has received recent critique (Kaustia, 2010, Lehenkari, 2012, Summers and Duxbury, 2012), suggesting that an alternative explanation of the disposition effect is required. The second section reviewed research on investor's disposition effect. I found that whilst evidence for the disposition effect is robust, no research had been completed on UK investors. The focus of disposition effect research has shifted to predicting susceptibility to the bias, with investor sophistication and experience being the major variables considered. This section included a critical review of the proxies used to measure sophistication and experience. I outlined that a gap in literature is that there is no research on the use of stop loss strategies to inoculate

against the disposition effect. The final section highlighted a further gap in the literature. That is, research on susceptibility to the disposition effect has not incorporated psychological explanations. Furthermore, the current sophistication and experience arguments are limited in the extent to which they explain what an investor is doing differently to avoid susceptibility to this bias.

Chapter 3. Literature review of psychological variables

The previous chapter reviewed the theoretical causes of the disposition effect and the literature which has investigated susceptibility to this bias based on sophistication and experience arguments. A critique of these arguments is that they move away from the psychological theories used to explain the disposition effect. Also both the sophistication and experience arguments do not explain what an investor is doing differently to avoid susceptibility to this bias. The aim of this chapter is to respond to these critiques by providing two psychological explanations of why an investor maybe susceptible to this bias. Specifically, these explanations are based on dual process theory and emotion regulation. The chapter is structured around three sections. The first is a review of experimental research which has investigated the relationship between the disposition effect and other psychological theories. The second section reviews dual process theory and then uses it to explain susceptibility to the disposition effect. The third section reviews research and theory on emotion regulation and then argues that differences in reappraisal and suppression can explain susceptibility to this bias.

3.1 Experimental research on the disposition effect

This section reviews disposition effect literature which uses an experimental design. An experiential research design for the disposition effect normally involves participants making mock trading based decisions in a computer game which mimics stock market investment (Chui, 2001, Weber and Camerer, 1998). An advantage of this methodology is that through

controlled manipulations researchers can ascertain what variables are associated with the disposition effect. Most of the manipulations have involved changing the manner in which participants make decisions and investigating if this increases or decreases the disposition effect (Brown and Kagel, 2009, Kirchler et al., 2005, Oehler et al., 2003, Shafran et al., 2009, Summers and Duxbury, 2012, Weber and Camerer, 1998). A problem with this approach is a possible Hawthorne effect, where participants change their behaviour as a result of being observed. Also the focus of this research is not specifically looking at individual differences in susceptibility to the disposition effect, but how subtle changes to the decision making process influence this bias. However, this research does offer relevant findings and these are reviewed below.

Weber and Camerer (1998) constructed a trading experiment to determine whether or not participants would exhibit the disposition effect using a range of reference points in a laboratory setting. Using a simplified stock market experiment, they showed that participants were reluctant to trade losses and eager to trade gains. They also manipulated the participants' reference point by making them focus on a price from a previous trading period. They found that when this price was used as a reference point, participants still exhibited the disposition effect. Finally, they also found that when participants were forced to sell stock they were unlikely to re-buy stock which was trading at a loss. This finding suggests that the use of stop losses would be an effective tool at curbing the disposition effect because it breaks an investor's attachment to the stock. Oehler et al. (2003) conducted similar research to Weber and Camerer (1998) and had similar findings. They found that the disposition effect was stronger when the purchase price was used as a reference point than when a price from the previous trading period was used.

Other experimental research has manipulated the manner in which participants make decisions to see if this influences the disposition effect. As mentioned in Chapter 2, Rubatelli et al (2005) manipulated the way in which losses and gains were presented to participants. They found that framing the gain or loss as a percentage of the participants' holding reduced the disposition effect. Brown and Kagel (2009) simplified participants' investment decisions so that they could only invest in one stock at a time. They found no evidence of the disposition effect in their experiment. Shafran et al. (2009) found no evidence of the disposition effect in a simplified experiment where participants could only hold three assets at a time. However, they did observe a disposition effect when participants were presented with information about their gains and losses relative to market based returns. The research by Brown and Kagel (2009) and Shafran et al. (2009) suggests that experimental research must closely mimic real life investment decisions in order to observe a disposition effect. Summers and Duxbury (2012) researched whether the participants buying the stock themselves or inheriting the stock bought would influence the disposition effect. As mentioned in Chapter 2, they found that when participants inherited the stocks, they did not exhibit the disposition effect but when participants bought the stock they did exhibit the disposition effect. Summers and Duxbury (2012) infer that the emotions of regret and elation drive the disposition effect.

Lee et al. (2008) researched the influence that priming participants with instructions prior to a trading experiment would have on the disposition effect. They found two ways to significantly reduce the disposition effect. One involved having participants systematically calculate the expected value of six different prospects before participating in the

experiment. This calibrated participants' evaluations of gains and losses in accordance with expected utility theory and reduced the disposition effect. Lee et al (2008) suggest that prospect theory is the underlying cause of the disposition effect because it was the value that participants assigned to losses and gains that caused this behaviour. When a participant's values were calibrated in accordance with normative rational behaviour, it reduced the disposition effect, supporting the idea that the disposition effect is normatively irrational behaviour. The other priming condition involved instructing participants to trade as if the investment was owned by another person and this also significantly reduced the disposition effect. Lee et al (2008) argue that this made participants indifferent to gains and losses. They argue that this also suggests that it is the value that people attach to gains and losses that causes the disposition effect.

Two research papers have investigated the relationship between personality and susceptibility to the disposition effect. Firstly, Chui (2001) found that the locus of control is significantly correlated with the disposition effect. They argue that people with an external locus of control are less likely to feel responsible for losses and will be less likely to be loss averse. People with an internal locus of control are more likely to believe their failures are directly related to their own judgements and will be more loss averse. His research finds that those participants with an internal locus of control are more likely to exhibit the disposition effect. Secondly, Weber and Welfens (2008) investigated the stability of the disposition effect. They found that susceptibility to the bias remained stable over time (a four week period) and on different tasks. From this they inferred that the disposition effect could be viewed as a personality based trait. They also found that participants who sold

gains too early were not the same as participants who held losses too long. They referred to this as splitting the disposition effect.

Overall, experimental research on the disposition effect has shown ways in which the context of decision making can be altered to influence the amount of disposition effect observed. A critique of experimental research on the disposition effect is that the focus has not been to examine susceptibility to the disposition effect at the individual level. The focus has been on manipulating the context to influence behaviour, rather than examining individual characteristics which might predict susceptibility to the disposition effect. An exception to this is Chui (2001) who found that the locus of control predicts susceptibility to the disposition effect. However, the focus of most experimental research has been to manipulate the design of the decision to understand the mechanisms of the disposition effect. A different field of research has shown that individual differences in susceptibility to the disposition effect do exist (Shapira and Venezia, 2001, Weber and Welfens, 2008). Experimental research on the disposition effect is yet to delve specifically into this research focus.

3.2 Dual process theory and the disposition effect

This section introduces a new method for identifying individual differences in the disposition effect which incorporates psychological theory. This is that individual differences in cognitive style as outlined by dual process theory will explain an investor's susceptibility to the disposition effect. The structure of this argument is as follows: firstly, it introduces what dual process theory is, then it outlines three different paradigms on dual process theory.

Using one of these paradigms as a theoretical framework, it examines how it would explain susceptibility to the disposition effect and proposes two research hypotheses.

Dual process theory has been a somewhat recent development in the field of cognitive research (Sloman, 1996, Stanovich and West, 2000) but its origins can be traced to Plato (Frankish and Evans, 2009). Proponents of dual process theory argue that people process information in two distinct but intertwined approaches: one is an *intuitive* system and the other is a *reason based* system. These systems have been researched by many authors using different names and slightly different definitions. Some of the most common names are the associative system & rule based system (Sloman, 1996, Sloman, 2002), tacit thought processes & explicit thought process (Evans and Over, 1996) and experiential system & rational system (Epstein, 1994). A review of the different names is presented by Stanovich and West (2000) who create a joint label and definition named system 1 and system 2, which has been adopted for 10 years in judgement and decision making research (Evans, 2008). A definition of these two cognitive processes is outlined in Table 3:1 below. The essence of these definitions is to differentiate between decisions which rely on fast, automatic and associate cognitive processes from those which rely on slow, effortful and deductive cognitive processes. Dual process theory also assumes that emotionally based cognition is strictly encapsulated in system 1 processes, and not system 2 processes (Epstein, 1994).

Table 3:1 Definitions of system 1 and system 2 cognition

System 1 (Intuitive)	System 2 (Reflective)
Process Characteristics	
Automatic	Controlled
Effortless	Effortful
Associative	Deductive
Rapid, parallel	Slow, serial
Process opaque	Self-aware
Skilled Action	Rule application
Content on which Processes Act	
Affective	Neutral
Causal propensities	Statistics
Concrete, specific	Abstract
Prototypes	Sets

(Kahneman and Frederick, 2002, p. 51)

There are many dual process theories of cognition. In a review of these theories, Evans (2008) traces the application of dual process theory to three paradigms; the first he refers to as the deductive reasons paradigm, the second he refers to as the judgment and decision making paradigm, and the third he refers to as the social cognition paradigm. Each paradigm has developed a different perspective about how the cognitive systems operate together.

The reasoning paradigm is associated with the work of Wason and Evans (1974) and investigates cognitive methods of reasoning. From this perspective, it is believed that system 1 processes work on an associate basis and the ability to reason and apply abstract ideas is a related to system 2 processes (Stanovich and West, 2000). The judgement and decision making paradigm, which is characterised by heuristic and bias research (Gilovich et al., 2002, Kahneman et al., 1982), views system 2 processes as intervening and correcting system 1 processes. This is referred to as a default interventionist approach (Evans, 2008)

and dual process theory is used to explain why bias occurs. Under this perspective, system 1 processes equate with heuristics and leads to normatively irrational decision making. However, the use of System 2 processes, if adopted and if the computational ability exists, can ensure that decision making is closer to normatively rational models (Kahneman, 2003, Kahneman and Frederick, 2002, Kahneman and Frederick, 2005). Finally, the social cognition paradigm views the two systems as parallel competitive. This entails that the two systems operate simultaneously, are isolable and generate conflicting thoughts (Sloman, 1996). Research from the social cognition paradigm has focused on issues concerning consciousness, free will, and the implications for moral and legal responsibilities of individuals (Evans, 1984). As I focus on susceptibility to the disposition effect, the dual process theory from the judgement and decision making paradigm is of more relevance because it is utilised to predict susceptibility decision making bias. Thus, the perspective of dual process theory reviewed is that from the judgement and decision making paradigm.

Research in the judgement and decision making paradigm has primarily been concerned with uncovering ways in which people deviate from normative rational behaviour outlined in neo-economic models of decision making (for examples see Gilovich et al., 2002, Koehler and Harvey, 2004). Dual process theory has been applied retrospectively as a method for describing why these errors occur. Kahneman (2003, p. 717) outlines this model of decision making as the following:

1. An intuitive judgment or intention is initiated, and
 - (a) Endorsed by System 2;
 - (b) Adjusted (insufficiently) for other features that are recognized as relevant;

- (c) Corrected (sometimes overcorrected) for an explicitly recognized bias; or
 - (d) Identified as violating a subjectively valid rule and blocked from overt expression.
2. No intuitive response comes to mind, and the judgment is computed by System 2.

From the judgement and decision making perspective, cognitive errors occur due to system 1 processes which are essentially heuristic based responses. However, the two processes work in co-ordination so system 2 is responsible for detecting errors made by system 1 and intervening in decision making (Kahneman, 2003, Kahneman and Frederick, 2005).

Kahneman (2003, p. 710) states “this assumption implies that errors of intuitive judgment involve failures of both systems: System 1, which generates the error, and system 2, which fails to detect and correct it”. This perspective offers a reason why an investor maybe susceptible to the disposition effect; that is, they use system 1 processes when faced with a loss or gain to decide whether or not to sell a stock. This perspective also offers a reason why an investor maybe less susceptible to the disposition effect; that is, through the use of system 2 processes an investor can overcome this bias. This view differs from the normative rationality in neo-economics underlying finance models such as the EMH because it allows for individual differences in the ability and use of system 1 and system 2 processes, to influence the extent to which bias decisions are made. A critical review of the above two arguments is presented next. Firstly, an argument is presented which shows that system 1 processes lead to an increase in the disposition effect. Then an argument is presented that system 2 cognitive processes can decrease the disposition effect. From these two arguments, research hypotheses are proposed.

3.2.1 System 1 cognitive process induce the disposition effect

Chapter 2 outlined that the framing effect and narrow framing are causes of the disposition effect. The argument presented by Kahneman (2003) and Kahneman & Frederick (2005) is that cognitive bias, such as the framing effect and narrow framing, are induced by system 1 processes. Kahneman and Frederick (2005) argue that because system 1 processes work on an associative basis, they are more inclined to utilise information which is accessible. Therefore, the framing and reflection effects occur because people utilise the salient information, which contains a positive or negative emphasis, to determine their choice. Likewise, narrow framing occurs because gains and losses pertaining to one stock are more accessible than changes in portfolio wealth. From this perspective, system 1 processes will result in the disposition effect.

In support of Kahneman and Frederick's (2005) argument, De Martino et al. (2006) found that the framing effect was correlated with activation of the emotional part of the brain. They state "increased activation in the amygdala was associated with subject's tendency to be risk averse in the Gain frame and risk-seeking in the Loss frame, supporting the hypothesis that the framing effect is driven by an affect heuristic underwritten by an emotional system" (De Martino et al., 2006, p. 686). Kahneman and Frederick (2007) interpret these results as evidence that system 1 processes are related to framing and reflection effects. Whilst some research has used neurological evidence as a basis for dual process theory (Lieberman, 2003, Lieberman et al., 2004), others have argued it is too early to draw substantive conclusions from this research methodology (Keren and Schul, 2009). However, the findings of De Martino et al. (2006) are indicative that the reflection and

framing effects are related to system 1 processes, implying that they may also cause the disposition effect.

A critique of the perspective that intuition leads to bias in decision making is that heuristic based decision making does not always result in bias. Gigerenzer (1991) argues that biases identified by the judgement and decision paradigm occur because of problems with the ecological validity of their experimental design. Ecological validity is the question of whether or not social scientific findings are applicable to people's everyday natural social settings (Bryman and Bell, 2003). Gigerenzer (1991) argues that human cognition does not utilise probabilities but works in frequencies. He shows that by changing the methodology of the experiment to incorporate frequencies, the biases identified by judgement and decision making paradigm can be substantially reduced. In subsequent research they show that the adoption of heuristics in natural contexts can improve decision making performance (Gigerenzer, 2004, Gigerenzer et al., 1999). This implies that heuristics and intuition can lead to optimal decision making when used in everyday decisions. In relation to Gigerenzer's critiques, the disposition effect is a bias which occurs in a natural context so it has strong ecological validity, yet, there is little evidence on whether intuition is related to the disposition effect. By investigating this relationship in a real world setting, this thesis has the ability to empirically test whether or not intuition is associated with this bias.

A second critique of the theory that intuition causes bias is offered by Klein and colleagues (1999, Lipshitz et al., 2001, Phillips et al., 2004). Their research into naturalistic decision making found that the decision making of experts followed an intuitive model (referred to as the recognition-primed decision model) rather than systematised and rationalised

decisions. Furthermore, when decisions were made using intuition they were very accurate and when systematic approaches were adopted they were inaccurate (Klein, 1999). This research indicates that expert decision makers follow a system 1 approach to making decisions. A finding that does not reconcile with a view that system 1 leads to decision making bias. Recently, Kahneman and Klein (2009) have worked together to reconcile the differences in their research and set out the conditions in which intuition can become non-bias. The research suggests that the correct environment which allows learning is essential and that experience by itself will not correct bias. In relation to the disposition effect, research has shown that expert traders do suffer from the disposition effect (Jordan and Diltz, 2004, Locke and Onayev, 2005) even though this is to a lesser extent than individual investors (Brown et al., 2006, Chen et al., 2007). Also the sophistication and experience arguments outlined in Chapter 2 indicate that investors with better knowledge will have less susceptibility to this bias. This suggests that the system 1 processes of experienced and sophisticated investors are better at making judgements and should have less bias in decision making. Whilst the focus of this research is whether the intuition of non-expert decision makers is related to the disposition effect, it should also consider the influence that both sophistication and experience will have on both system 1 processes and the disposition effect. The hypothesis pertaining to the relationship between system 1 cognition and the disposition effect is:

H8: Investors who have a higher reliance on system 1 based cognition will exhibit the disposition effect to a greater extent

3.2.2 System 2 cognitive processes reduce susceptibility to the disposition effect

The second aspect of the dual process theory espoused by the judgement and decision making literature is that using system 2 cognitive processes reduces bias. A reason why decision making bias occurs is due to the inability of System 2 processes to constantly intervene. In support of this theory, research has found that exercising self-control requires cognitive effort and, in the short term, can get depleted if used too much (Baumeister et al., 1998, Muraven and Baumeister, 2000, Muraven et al., 1998), suggesting that most decisions are made by system 1, whilst system 2 intervenes sporadically.

A method of illustrating that system 2 cognitive processes reduce bias in decision making is to measure individual differences in system 2 cognition and relate this to susceptibility to bias in decision making (Cacioppo and Petty, 1982, Epstein et al., 1996, Frederick, 2005, Pacini and Epstein, 1999, Stanovich and West, 2002). Pacini et al. (1999) found that participants higher in system 2 processing were less likely to make errors when choosing between a 1/10 lottery and a 7/100 lottery. Moreover, the influence of system 2 in decreasing bias was more pronounced when incentives were increased for participants. Kogler and Kuhnberger (2007) found that priming participants in accordance with system 2 cognition reduced the extent to which participants made errors in a diversification bias.

Research has investigated whether or not individual differences in system 2 cognition relate to susceptibility to framing effects and reflections effects (LeBoeuf and Shafir, 2003, Shiloh et al., 2002, Smith and Levin, 1996). Framing effects are said to occur whenever alternative descriptions of what is essentially the same decision problem give rise to predictably

different choices (Tversky and Kahneman, 1981). The reflection effect is when people prefer risk taking for loss scenarios and risk aversion for gain scenarios (Kahneman and Tversky, 1979). The framing effect and reflection effect can be measured using vignettes, which are defined below and then research on dual process theory and the framing effect is reviewed. One method of measuring the framing effect is through the Asian disease vignette (Tversky and Kahneman, 1981), where participants are asked to choose between two options. The Asian disease vignette for the framing effect is outlined as follows (Tversky and Kahneman, 1981, p. 453):

Problem 1: Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is $\frac{1}{3}$ probability that 600 people will be saved and $\frac{2}{3}$ probability that no people will be saved.

Which of the two programs would you favor?

Now consider this problem with a slightly different verbal description of the outcomes:

Problem 2:

If Program C is adopted, 400 people will die.

If Program D is adopted, there is $\frac{1}{3}$ probability that nobody will die and $\frac{2}{3}$ probability that 600 people will die.

Which of the two programs would you favor?

The framing effect occurs when there is a significant difference in the number of participants who prefer to take the risky option over the certain option when presented with a negatively framed outcome. Specifically, a larger number of participants will choose program D in option 2 because it is negatively framed as 400 people will die. However, when the same scenario is framed positively, more participants will choose the less risky option. Specifically, a larger number of participants will choose program A because it is framed as 200 people will be saved.

The reflection effect is measured with prospect theory vignettes where participants choose between taking a certain gain (loss) or a chance to gain (lose). An example of a prospect theory framing vignette is as follows (Frederick, 2005, p. 34):

Gain scenario

A) \$100 for sure or a 75% chance of \$200

Loss scenario

B) Lose \$100 for sure or a 75% chance to lose \$200

According to prospect theory, people will be more willing to take risks to avoid losses and less willing to take risks when there are certain gains. This vignettes tests this. A reflection effect occurs when more participants choose to take the risky option for loss scenarios and more participants choose to take the certain option for gain scenarios. Specifically in situation B), more participants choose to take the '75% chance to lose \$200' than the 'lose

\$100 for sure' option. However, in situation A) more participants choose to take the '\$100 for sure' over the '75% chance of \$200' option.

Stanovich and West (1998) used the Scholastic Aptitude Test (SAT) as a proxy for individual differences in system 2 cognitive ability and researched the relationship between SATs and the framing and reflection effects. They found that participants with higher SAT scores showed less framing effect but not less reflection effect. Susceptibility to the framing effect as measured through the Asian disease vignette was correlated with individual differences in cognitive style in some experimental research (Bjorklund and Backstrom, 2008, Simon et al., 2004, Smith and Levin, 1996) but other experimental research did not find a significant result (LeBoeuf and Shafir, 2003, Levin et al., 2002, Levin et al., 1998, Shiloh et al., 2002). Simon et al (2004) investigated the reason for these contradictory results and found that the mitigating factor is the level of engagement shown by the participants in the experiment. That is, when participants were involved with the activity, individual differences in cognitive style were predictive of susceptibility to the framing effect. This finding echoes other results which found that engagement along with individual differences in cognitive style can predict susceptibility to bias (Pacini and Epstein, 1999).

A concept related to system 2 cognition is cognitive reflection (Frederick, 2005). Frederick (2005) devised a cognitive reflection test to measure an individual's ability use system 2 cognition to intervene when system 1 cognition makes an error. His test involves three questions and for each question, an incorrect, intuitive answer is apparent. The questions are as follows (Frederick, 2005, p. 27):

(1) A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball.

How much does the ball cost? _____ cents

(2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take

100 machines to make 100 widgets? _____ minutes

(3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size.

If it takes 48 days for the patch to cover the entire lake, how long would it

take for the patch to cover half of the lake? _____ days

The incorrect intuitive answers are 10, 100 and 24, respectively, and the correct answers are 5, 5 and 47, respectively. Frederick (2005) argues that the number of correct answers given by a participant is indicative of their ability to cognitively reflect. He found that participants who scored higher on the cognitive reflection test were less susceptible to the reflection effect because they were less likely to take on more risk when moving from a gain to a loss scenario. Whilst the cognitive reflection test shows predictive ability for decision making bias, the test is focused purely on cognitive ability. The review in chapter 2 argued that the antecedents of the disposition effect are emotional (Summers and Duxbury, 2012). Therefore, the use of the cognitive reflection test to predict individual differences in the disposition effect is not adopted in this thesis. Despite this, Frederick's (2005) research supports the theory that system 2 cognition can detect errors and reduce susceptibility to bias.

In summary, research has shown that individual differences in cognitive style are predictive of susceptibility to bias consistent with the reflection effect and framing effect, given engagement with the task. Given the financial stakes, it could be expected that investors

are highly engaged with their investment decisions. Therefore, individual differences in system 2 cognitive processes are hypothesised to be predictive of an investor's susceptibility to the disposition effect. The hypothesis is:

H9: Investors who have a higher reliance on system 2 based cognition will exhibit the disposition effect to a lesser extent

This section outlined how dual process theory can be used to explain susceptibility to the disposition effect. That is, system 1 process can lead to bias decisions and system 2 works as default interventionist stopping bias if a problem is detected. From this it was hypothesised that investors with higher reliance on in system 1 cognition would be more susceptible to this bias and investors with higher reliance on system 2 cognition would be less susceptible to this bias. However, the dual process theory espoused by the judgement and decision making paradigm has received some criticism (Gigerenzer and Regier, 1996, Osman, 2004, Keren and Schul, 2009). The next section reviews these critiques and proposes an alternative method of predicting individual variation in the disposition effect based on emotion regulation.

3.3 Emotion regulation and the disposition effect

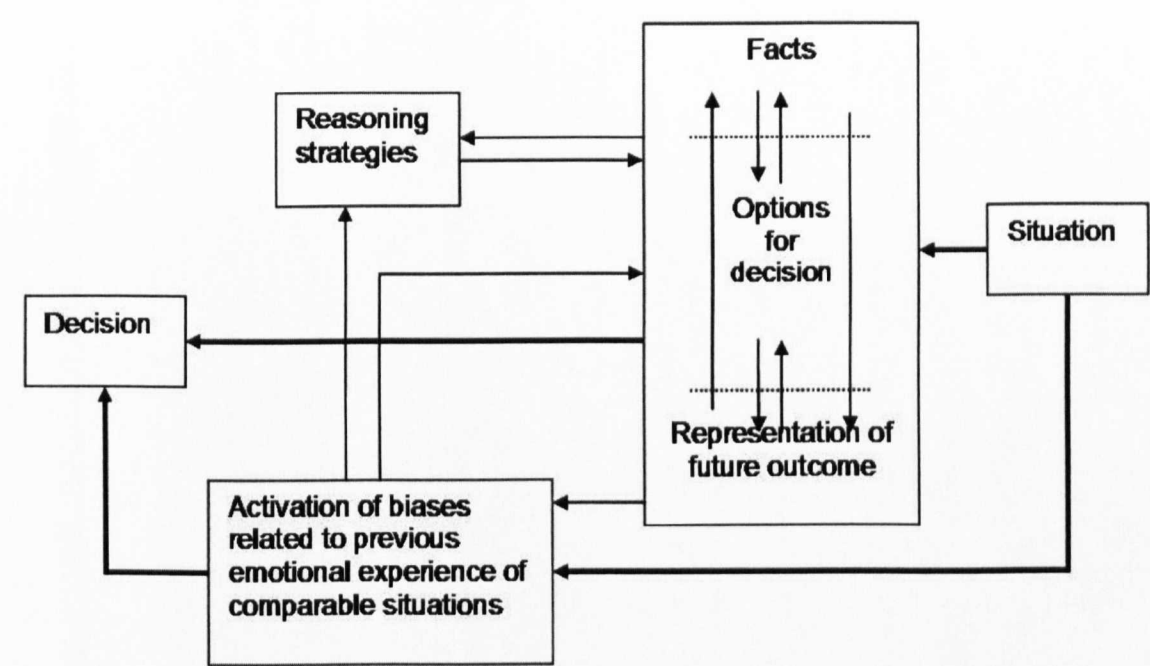
Dual process theory is not without its critiques. Kerren and Schul (2009) and Osman (2004) argue that cognition should not be categorised as two dichotomous systems working against each other. Creating a dichotomy of cognition creates the view that cognitive systems are separate from one another and it also ignores possible interaction between them. Kerren & Schul (2009) elaborate that dual process theory implies that cognition is either hot or cold,

and either affective or affect absent. This is particularly relevant to decision making.

Damasio (1994) notes that a commonly held belief is that emotions and reason do not mix and that optimal decision making involves keeping a cool head. However, his clinical observations of patients who have brain lesions in the part of brain that processes emotions (the ventromedial prefrontal cortex and amygdala) showed that they made impaired real life decisions despite having a normal intellect. Similarly cognitive neuroscience research, as reviewed by Phelps (2006), argues that many aspects of cognition are intertwined with emotion. Whilst earlier theories argue that cognition precedes affect (Lazarus, 1984) and others that affect precedes cognition (Zajonc, 1984), a prevailing current view is that cognition and emotion work simultaneously (Bechara et al., 1997). This view is increasingly being incorporated into research into decision making (Loewenstein and Lerner, 2003, Loewenstein et al., 2001).

Bechara et al. (1997) outline a dual process model which allows for interaction between different cognitive processes and includes affect as a major influence (refer to Figure 3:1 below). They state “a decision leads to two largely parallel but interacting chains of events. In one, either the sensory representation of the situation or the facts evoked by it activate neural systems that hold non-declarative dispositional knowledge related to the individual’s previous emotional experience of similar situations... In the other chain of events, the representation of the situation generates (i) the overt recall of pertinent facts... and (ii) the application of reasoning strategies to facts and options” (Bechara et al., 1997, p. 1294). Although this model is a dual process model, it does allow for interaction between reasoning strategies and intuition and also includes affect as influencing all aspects of decision making.

Figure 3:1 Dual process theory as an intertwined and affective process



Source: Bechara et al. (1997, p. 1924)

Bechara et al. (1997) created an experiment to compare patients with brain lesions in the amygdala and ventromedial prefrontal cortex to people without brain lesions, in their ability to decipher risk and act accordingly. These experiments demonstrated that patients with brain lesions failed to behave in a risk averse manner. Furthermore, they also showed that participants without brain lesions had significant emotional reactions to risky options prior to consciously comprehending the risks involved. These two results indicate that there is a link between emotion and risk assessment (Bechara and Damasio, 2005). This research has not specifically investigated the use of emotions in investment decision making and this thesis investigates the relevance this.

There is debate as to whether emotions are beneficial or detrimental to decision making. The research conducted by Bechara et al. (1997) illustrated a situation in which emotional reactions guided participants to make better decisions by avoiding risky options. However, Lowenstein et al. (2003) argued that this result occurred due to the design of the experimental task which favoured risk aversion. Subsequently, it was shown if the context was altered so that risk seeking behaviour is advantageous, patients with brain lesions outperformed people without brain lesions (Shiv et al., 2005a, Shiv et al., 2005b). These results indicate that emotions can be both beneficial and detrimental to decision making performance.

These findings have been echoed in empirical research on emotion and financial decision making. Lo, Repin and Steenbarger (2005) researched the emotional state of traders using an emotional state survey. They compared this measure of emotion to the traders' decision making performance using their profit and loss accounts. They found that traders who experienced more intense positive and negative emotional reactions to their gains and losses performed worse. This suggests that emotions are bad for financial decision making. However, Seo & Barret (2007) researched the emotional state of investment club members as they made investment decisions. Using a very similar methodology to Lo et al. (2005) they found that investors who experienced more intense emotions had better performance on investment decisions. This suggests that emotions are good for financial decision making.

These contradictory findings suggest that focusing on whether emotion is a hindrance or help to decision making is the wrong approach to understand susceptibility to bias. An alternative avenue for investigating the role that emotions take in decision making bias is to investigate how investors engage with and manage their emotions whilst making decisions. This position is summarised by Fenton O’Creedy et al. (2011b, p. 1056) who state “to ask whether emotion disturbs or aids traders’ decision making is to ask the wrong question. Traders’ emotions and cognition are inextricably linked. Therefore a more productive question to ask in this context is whether there are more or less effective strategies for managing and using emotion in financial decision making.” This thesis utilises emotion regulation as an explanation for differences in individual susceptibility to the disposition effect. Next a review of emotion regulation is outlined and from this two hypotheses are proposed.

3.3.1 Emotion regulation

Emotion regulation has been defined as “the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals” (Thompson, 1994, pp. 27-28). A different definition is offered by Gross (1998, p. 275) who defines it as “the processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions.” From these definitions it is possible to see that emotion regulation is a deliberate process. It differs from general consciousness in that it is intentional and used in order to achieve specific goals. In relation to the process of aspect of emotion regulation, Gross (2001, Gross and Thompson, 2007) outlines a model to separate different emotion regulation methods by when they occur during the unfolding of

an emotional episode. In relation to goal aspect, Koole (2009) outlines a function based classification of emotion regulation so that methods can be differentiated by what they hope to achieve. Both of these emotion regulation frameworks are outlined next.

Gross' (2001, Gross and Thompson, 2007) framework, outlined in Figure 3:2, shows different emotion regulation strategies as they unfold over an emotion episode. Gross and Thompson , (2007, p. 11) define situation selection as taking actions that make it more (or less) likely that one will end up in a situation one expects will give rise to desirable (or undesirable) emotions. Situation modification is the process of modifying the situation in order to alter its emotional impact, where modification is though changing the external, physical environment. Attentional deployment is emotion regulation through selecting which of the many aspects of the situation are focused on. Cognitive change is changing how one appraises the situation they are in as to alter its emotional significance, either by changing how they think about the situation or about their capacity to manage the demands it poses. Finally, response modulation refers to influencing physiological, experiential, or behavioral responding as directly as possible (see Gross and Thompson, 2007, pp. 14 - 15). This framework is also very applicable to financial decision making bias as it has been useful for discerning emotion regulation strategies of professional traders in currency, stock and bond markets (Vohra and Fenton-O'Creevy, 2011, Fenton-O'Creevy et al., 2011b).

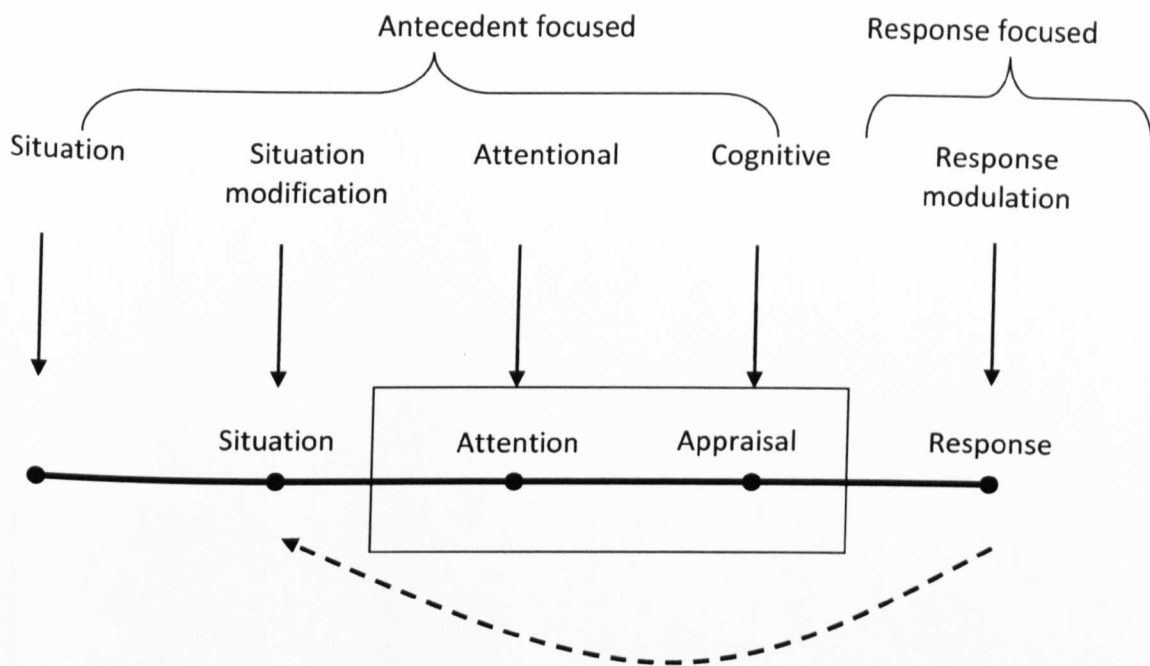


Figure 3:2 Emotion regulation strategies associated with stages in an emotional episode

Source: (Gross and Thompson, 2007, p. 10)

Of the emotion regulation strategies outlined by Gross (1998), the two strategies that have received the most research attention are cognitive change and response modulation (John and Gross, 2007). The emotion regulation strategy researched under cognitive change is called reappraisal and it is defined as “cognitively changing a situation’s meaning in a way that alters its emotional impact”(Gross and Thompson, 2007, p. 14). The response modulation emotion regulation strategy is called expressive suppression and this “involves inhibiting ongoing emotion-expressive behavior”(Gross and John, 2003, p. 349). These two strategies have received attention because reappraisal is an antecedent strategy that regulates the emotion as it emerges. Whereas, expressive suppression is a response focused strategy because it regulates an emotion after it has been experienced.

A different method of classifying emotion regulation is offered by Koole (2009) who classifies different emotion regulation methods by what they hope to achieve. He outlines that there are three psychological functions of emotion regulation: need, goal and person orientated emotion regulation. "Need orientated emotion regulation is driven by people's needs to experience hedonically rewarding states, which consist of low levels of negative and high levels of positive emotion"(Koole, 2009, p. 18). Need orientated emotion regulation involves maintaining a level of hedonic tone, or pleasurable feelings, so people engage in emotion regulation to maintain this need. "Goal-oriented emotion regulation is directed by a single verbally reportable goal, norm, or task."(Koole, 2009, p. 22). Goal orientated emotion regulation is used by someone because emotions impede them in attaining a goal. Finally, "Person-oriented emotion regulation maintains the integrity of the overall personality system, which consists of the entirety of a person's needs, goals, motives, and other self-aspects"(Koole, 2009, pp. 22-23). Person orientated emotion regulation involves engaging with emotions because a person wants to maintain the personality they portray.

Koole (2009) classifies reappraisal and expressive suppression as goal orientated emotion regulation strategies but distinguishes them by cognitive or body focus. Reappraisal is a cognitive goal orientated emotion regulation method because it lessens the impact through mentally construing a situation to be different. Expressive suppression is also a goal orientated strategy but has a different focus as it aims to inhibit bodily expression. Koole (2009, p. 25) summarises the effectiveness of these methods by stating "relatively effective goal-oriented strategies use cognitive reappraisal, a process that modifies the emotional

impact of events by changing people's assessments of these events. Some of the least effective goal-oriented strategies target bodily expressions of emotion, through processes such as expressive suppression".

Research that compared reappraisal to expressive suppression has found that there are stable individual differences in the use of the strategies and that they also have different consequences on affect, cognition and social consequences (Gross and John, 2003, John and Gross, 2004, John and Gross, 2007). In relation to affect it was found that reappraisal is more effective than expressive suppression at curtailing the emotion being experienced (Gross, 2002). Specific use of expressive suppression did not inhibit the emotion being experienced after participants were exposed to emotion eliciting movies (John and Gross, 2004). Personality level comparisons between expressive suppression and reappraisal tendencies found that chronic use of reappraisal is correlated with more positive emotion, whereas chronic use of expressive suppression is correlated with more negative emotion (John and Gross, 2007). In relation to cognitive consequences, research has found that expressive suppression is more cognitively taxing than reappraisal because whilst using it working memory reduces (John and Gross, 2004). Finally, trait level expressive suppression (i.e. the habitual use of expressive suppression strategies) is related with more social problems such as avoidance of close relationships and a lack of emotional closeness with peers (Gross and John, 2003).

Specifically in the domain of financial decision making, Fenton-O'Creevy and colleagues (Fenton-O'Creevy et al., 2005, Fenton-O'Creevy et al., 2011b, Vohra and Fenton-O'Creevy,

2011) have shown that emotion regulation is pertinent to successful decision making in financial markets. Fenton O’Creedy et al. (2005) conducted interviews with 118 traders at investment banks and found that emotions and management of them were essential to achieve higher levels of expertise. The qualitative analysis showed that clear differences in description of emotion regulation strategies emerged between novice traders, experienced low performers and experienced high performers (Fenton-O’Creedy et al., 2011b). Vohra & Fenton O’Creedy (2011) extended the present findings by documenting domain specific emotion and emotion regulation strategies. They state that “the traders with low levels of experience tend to adapt a more passive approach to management of emotions and their approach tends to be more one of suppression and situation avoidance”(Vohra and Fenton-O’Creedy, 2011, p. 30). They found that developing antecedent emotion regulation strategies, such as reappraisal, is associated with a progression in trader expertise. These findings suggest that antecedent emotion regulation is adopted by adaptive agents who optimize their ability to make decisions in a bounded rationality environment. This type of behaviour is consistent with arguments that human rationality is adaptive (Anderson, 1991, Gigerenzer and Brighton, 2009, Haselton et al., 2009).

Research has now begun to look at the influence of reappraisal and expressive suppression in other domains, including task focus and work performance (Wallace et al., 2009) and decision making (Sokol-Hessner et al., 2009, Heilman et al., van’t Wout et al., 2010). Wallace et al. (2009) compared the individual differences in expressive suppression and reappraisal with performance on a simulated PC game and performance at work. They found that reappraisal was positively related to task performance and expressive

suppression was negatively related to task performance (via task focus) on the PC game.

This finding was replicated in two emotional work environments; retail and call centre work.

In the decision making domain, Sokol-Hessner et al. (2009) investigated the extent to which priming participants with reappraisal strategies would reduce loss aversion. They instructed participants in a reappraise condition to “imagine that this is your job and that the money at stake is not yours—it is someone else’s” and to “treat it as one of many monetary decisions, which will sum together to produce a ‘portfolio’” (Sokol-Hessner et al., 2009, p. 3). In the control group they instructed participants to “Tell yourself it is the only gamble that matters, that this one might be the one you get paid for” and “Ask yourself how you would feel if you won the positive amount, how you would feel if you lost the negative amount, and how you feel about the guaranteed amount” (Sokol-Hessner et al., 2009, p. 3). They presented both groups with prospect style scenarios to measure their loss aversion. They found that the reappraise condition showed substantially less loss aversion. Furthermore, the emotional response, measured by skin conductance response, was higher for losses than gains in the attend group. However, it did not significantly differ in the reappraise group.

Similarly, Heilman et al (2010) looked at the influence of reappraisal and expressive suppression on risk aversion. They induced fear and disgust into participants then gave them either reappraisal, expressive suppression or no emotion regulation instructions (control). After this, participants completed two tasks to assess their levels of risk. They found that the expressive suppression method did not differ from the control group in terms of their risk seeking behaviour. Heilman et al. (2010) concluded that expressive

suppression did not significantly alter the emotional experience. They also found that the reappraisal group were more risk seeking and concluded that reappraisal effectively down regulated the negative emotion. Their results suggest that reappraisal can mitigate risk aversion induced by negative emotions but expressive suppression cannot.

Finally, van't Wout et al (2010) investigated the difference between expressive suppression and reappraisal in a version of the Ultimatum Game by priming instructing with reappraisal and expressive suppression instructions. In this Ultimatum game there was \$10 up for offer. The participants had to choose to accept or reject a monetary amount on the basis that the other participant would receive the other part of the money offered. The amount of money offered was either \$1, \$2, \$3, \$4 or \$5 and the amount of money given to the other participant in the game (a computer) was \$9, \$8, \$7, \$6 or \$5, respectively. If they rejected the offer both parties got nothing. After playing the part of receiver, the participants then took the role of the proposer. Van't Wout (2010) found that the reappraisal group was more likely to accept a lower monetary offer than the expressive suppression group. This is of relevance for the disposition effect as it suggests that reappraisal maybe associated with the tendency to sell stocks at a loss. When the roles were reversed and the participants had the opportunity to be the proposer, the reappraisal group were not influenced by their prior offering when proposing. However, the expressive suppression group was statistically more likely to offer less money if they had received a small offering. This has relevance for the disposition effect as it suggests that when expressive suppression is used, the influence of prior events carries over to current decisions. Thus, the influence of a prior gain or loss may influence an investor's tendency to sell or not sell a stock.

In sum, research has shown that reappraisal is associated with better performance in an emotional work context (Wallace et al., 2009) and that reappraisal strategies reduce loss aversion (Sokol-Hessner et al., 2009). Furthermore, instructing participants to reappraise emotions aligned their decisions closer to what is normatively rational in the ultimatum game (van't Wout et al., 2010). Research on traders shows that emotion regulation is a key differentiator of expertise and that reappraisal emotion regulation methods are associated with expert traders (Fenton-O'Creevy et al., 2011b, Vohra and Fenton-O'Creevy, 2011). The literature review presented in Chapter 2 argued that a key reason why the disposition effect occurs is that investors use emotions whilst making decisions. In particular, Shefrin and Statman (1985) proposed that regret and pride are related to the disposition effect. Summers and Duxbury (2012) show that emotions, regret and elation in particular, are a key aspect of exhibiting the disposition effect. Finally, research has shown a link between Thaler's (1985) hedonic editing and the disposition effect (Kumar and Lim, 2008). This suggests the disposition effect has its roots in an investor's emotional experience of gains and losses. The literature on emotion regulation shows that reappraisal emotion regulation strategies are good at curtailing an emotional experience and associated with more positive affect (John and Gross, 2007). It is expected that investors who use reappraisal to regulate their emotions will be less influenced by these emotions when making these decisions. In turn they will exhibit the disposition effect to a lesser extent. Therefore, it is hypothesised that investors who report more frequent use of reappraisal when investing will exhibit the disposition effect to a lesser extent. The hypothesis is:

H10: Investors who are higher in reappraisal emotion regulation will exhibit the disposition effect to a lesser extent

Expressive suppression is associated with poorer performance on a task based game and emotional work (Wallace et al., 2009). Research has also shown that traders with low amounts of expertise are more likely to adopt this form of regulating emotions (Fenton-O'Creevy et al., 2011b). Finally, expressive suppression emotion regulation does not reduce the emotion experience and is more cognitively taxing than reappraisal (John and Gross, 2007). As expressive suppression is less effective at reducing the emotional experience and the disposition effect is somewhat driven by emotional reactions to gains and losses, it is expected that investors who use expressive suppression will exhibit the disposition effect to a greater extent. Therefore, it is hypothesised that investors who report more frequent use of expressive suppression emotion regulation whilst investing will exhibit the disposition effect to a greater extent. The hypothesis is:

H11: Investors who are higher in expressive suppression emotion regulation will exhibit the disposition effect to a greater extent

3.4 Conclusion

The previous two chapters have reviewed literature on the disposition effect, dual process theory and emotion regulation. From these literature reviews, 11 hypotheses were generated and a summary of these hypotheses are outlined in Table 3:2.

Table 3:2 Research Hypotheses

Hypothesis
H1: <i>In aggregate, investors in the UK will exhibit the disposition effect</i>
H2: <i>Investors who trade more complex financial products will exhibit the disposition effect to a lesser extent</i>
H3: <i>Older investors will exhibit the disposition effect to a lesser extent</i>
H4: <i>Older investors will exhibit the disposition effect to a lesser extent whilst controlling for average trade value</i>
H5: <i>Investors with more years of investment experience will exhibit the disposition effect to a lesser extent</i>
H6: <i>Investors with more cumulative trades will exhibit the disposition effect to a lesser extent</i>
H7: <i>Investors who use stop losses will exhibit the disposition effect to a lesser extent</i>
H8: <i>Investors who have a higher reliance on system 1 based cognition will exhibit the disposition effect to a greater extent</i>
H9: <i>Investors who have a higher reliance on system 2 based cognition will exhibit the disposition effect to a lesser extent</i>
H10: <i>Investors who are higher in reappraisal emotion regulation will exhibit the disposition effect to a lesser extent</i>
H11: <i>Investors who are higher in expressive suppression emotion regulation will exhibit the disposition effect to a greater extent</i>

Chapter 2 identified a gap in the literature for research on individual susceptibility to the disposition effect. This gap is that research has not investigated variability in individual susceptibility to this bias using psychological explanations in real market settings. This chapter reviewed literature on the disposition effect which uses an experimental design. The review found that very few papers had used psychological theory to predict individual differences in the disposition effect. Thus, the remainder of the chapter applied two psychological theories which could be used to predict investor susceptibility to the disposition effect. These are dual process theory and emotion regulation. Dual process has been used as an explanation of why bias occurs in decision making. I applied dual process theory to the disposition effect and hypothesised that investors who reported a higher reliance on system 1 cognition would exhibit the disposition effect to a greater extent. Also

investors who reported a higher reliance on system 2 cognition would exhibit the disposition effect to a lesser extent. In relation to emotion regulation, two strategies were reviewed; reappraisal and expressive suppression. The literature review showed that these two strategies have different influences on the emotions, social outcomes, task focus, work performance and decision making. I hypothesised that investors higher in reappraisal would exhibit the disposition effect to a lesser extent and investors higher in expressive suppression would exhibit the disposition effect to a greater extent. The next chapter outlines the methodology adopted to test the 11 research hypotheses proposed in this thesis.

Chapter 4. Methodology

The previous chapters presented the research questions and hypotheses of this thesis. The purpose of this chapter is to justify the methodology used to test these research hypotheses. This justification begins broadly in scope and then gradually narrows until the specific methods of measuring the variables are outlined. Thus, section one outlines the philosophy of business research and then describes the epistemological and ontological assumptions of this thesis. The second section investigates the predominant methodologies within the behavioural finance paradigm. It argues that the analysis of secondary data combined with a cross sectional design should be adopted to test the hypotheses. The third section reviews specific methods of measuring the dependent and independent variables. It covers the method for measuring the disposition effect, investor sophistication, gender, age and average trade value, years of experience, cumulative trades, stop losses, dual process theory and emotion regulation.

4.1 Philosophy of this research

The research design that is used in any research project is based on the epistemological and ontological assumptions made by the researcher. Crotty (1998) argues that there should be a logical progression from epistemology to theoretical perspective, to methodology and finally to the specific methods adopted in a research (refer to Table 4:1).

Table 4:1 Philosophy of research design

Epistemology	Theoretical perspective	Methodology	Methods
Way of understanding and explaining ‘how we know what we know’	Philosophical stance that lies behind the chosen methodology	Strategy, plan of action that lies behind the choice and use of particular methods	Technique or procedure used to gather or analyse data related to some research question or hypothesis

Adapted from Crotty (1998, p. 4)

According to Bryman and Bell (2003) and Easterby-Smith et al (2002), a philosophical debate about business research should consider two points; epistemology and ontology. Easterby-Smith et al (2002, p. 31) define epistemology as the “general set of assumptions about the best ways of inquiring into the nature of the world” and is inherently related to ontology which is defined as “assumptions that we make about the nature of reality”. Bryman and Bell (2003) note that there are a variety of different epistemological positions and they classify business research into two broad strands, logical positivism and interpretivism. Logical positivism is an epistemological position which applies the rules of natural science to the work of social sciences. A logical positivist epistemology assumes that knowledge is obtained from the observation of phenomena, the deductive generation of hypotheses and the inductive gathering of facts in an objective manner (Bryman and Bell, 2003, p. 14). According to Bryman and Bell (2003), logical positivism is associated with an objectivist ontology which asserts that social phenomena and their meaning have an existence that is independent of social actors. Research from a logical positivist epistemology seeks, through observation, to find the laws that govern social phenomena.

A contrasting position to epistemological positivism is interpretivism which argues that the application of natural science rules of research to social sciences is invalid (Bryman and Bell, 2003). According to Bryman and Bell (2003), an interpretivist epistemology argues that social science research cannot find causal explanations of human behaviour and that social science research should aim to understand human behaviour and the meaning humans attach to social reality. This epistemology is associated with a social constructionist ontology which asserts that “social phenomena and their meanings are continually being accomplished by social actors ... (and) are produced through social interaction” (Bryman and Bell, 2003, p. 20). Thus, interpretivist based research seeks to understand how people make sense of social phenomena.

This thesis draws on research from a logical positivist epistemology to generate its theoretical perspective. Specifically, it reviewed research from the behavioural finance and psychological decision making paradigms to generate research questions and hypotheses. Financial research is associated with a logical positivist epistemology as it has been influenced by neo-classical economic research (Ryan et al., 2002). In some ways, behavioural finance critiques the neo-classical economics underlying standard financial theories as it argues against the assumption of normative rationality (De Bondt and Thaler, 1995). However, these critiques are not epistemologically or ontologically based and the methodology adopted by behavioural finance research aligns with logical positivism. It is through the observation of phenomena (in trading data or market data) and the deductive application of models (based on psychological decision making research) that knowledge is created in the behavioural finance paradigm (Ryan et al., 2002). Similarly, psychological research on decision making also uses methods which align with a logical positivist

epistemology. The predominant method of deriving knowledge in this research paradigm comes from deductive theorising to generate hypotheses. These hypotheses are verified from observations of phenomena in constructed experiments (for example Gilovich and Griffin, 2002).

This thesis adopts a logical positivist social science epistemology because it aims to contribute knowledge to the behavioural finance and psychological decision making paradigms. As this contribution adds to existing knowledge, it is ideal that the same philosophy is adopted. By adopting a positivist epistemology it is assumed through observation and statistical inference that the hypotheses outlined in Chapter 2 and 3 can be tested. This epistemology entails an ontology that assumes the phenomena being observed, to some extent, exist independent of interpretation and social interaction. The main phenomenon in this research is the disposition effect which can be observed through analysis of trading data. Also the independent variables can be observed using demographic information and an online questionnaire. This epistemology and theoretical perspective relate to a methodology which uses quantitative analysis and methods of statistical inference (refer to Table 4:2). The methodology and methods are elaborated in the two subsequent sections.

Table 4:2 Philosophy of this thesis research design

Epistemology	Theoretical perspective	Methodology	Methods
Logical positivist	Behavioural finance Psychology of decision making	Analysis of secondary data and a cross sectional design	Survival analysis of trading data/ an online questionnaire

4.2 Methodology

Research on the disposition effect has predominantly come from two methodologies; experimental design (Weber and Camerer, 1998) and analysis of secondary data (Odean, 1998). Both of these methodologies treat the disposition effect as an element of risk rather than uncertainty. Knight (1921) argued that risk is a measurable construct and that uncertainty cannot be measured. Research on the disposition effect is risk based as it examines the extent to which an individual sells stocks depending on whether the stock is at a loss or at a gain (Odean, 1998, Weber and Camerer, 1998). This research does not consider the influence of uncertainty on the tendency to sell stocks.

An experimental design used to research the disposition effect involves participants trading stocks in an artificial stock investment environment (Weber and Camerer, 1998). This methodology is advantageous as it allows for the manipulation of specific variables in a controlled environment. There is greater certainty that the variable manipulated influences the disposition effect, increasing internal validity. Internal validity relates to the issue of causality and is concerned with the question of whether a conclusion that incorporates a causal relationship between two or more variables holds water (Bryman and Bell, 2003).

A critique of most experimental research is that it lacks ecological validity. Ecological validity is concerned with the question of whether or not social scientific findings are applicable to people's everyday, natural social settings (Bryman and Bell, 2003). To improve

ecological validity the settings and materials of the research need to approximate the real-life setting. In relation to the disposition effect, the experimental setting needs to approximate investing in a stock market. An area of concern is getting participants to maintain the same level of involvement that an investor would have with their decisions. The importance of this is highlighted by research in two experimental settings. Firstly, Summers and Duxbury (2012) show that participants must be involved in the decision to buy the stock to exhibit the disposition effect. Secondly, Lee et al. (2008) show that participants do not exhibit the disposition effect when advised to invest on behalf of someone else. These results testify the need for the participant to be involved in the decision to exhibit the disposition effect.

A second critique based on ecological validity is that experimental research often uses students as participants. This group of people will be younger and have significantly less experience than investors in general. This is problematic because research has found that the disposition effect is reduced by both experience (Feng and Seasholes, 2005, Seru et al., 2010) and age (Dhar and Zhu, 2006). A final critique about the ecological validity of experimental research on the disposition effect is that it is very difficult to replicate the market in a laboratory setting. Two papers support this critique because they found the disposition effect did not occur when the market was simplified for experimental settings. Brown and Kagel (2009) found no evidence of the disposition effect when they simplified participants investment decisions so that participants could only choose one stock at a time. Also, Shafran et al. (2009) found no evidence of the disposition effect in a simplified experiment but when they gave participants information about market based returns, the

disposition effect occurred. These critiques show that the context of share market decisions is essential for the disposition effect to occur.

The other methodology for research on the disposition effect involves the analysis of investors' trading data and is referred to as analysis of secondary data. A comparison is made between the investors' trading records and daily stock price data to determine whether stocks trading at a gain are more likely to be sold than stocks trading at a loss (Feng and Seasholes, 2005, Odean, 1998). This methodology has stronger ecological validity because it uses investors' actual decisions. Analysing this data is accurate at determining the existence of the disposition effect but a weakness exists when it is used to investigate susceptibility to the disposition effect. This weakness is the measurement validity of the independent variables. Measurement validity is to do with the question of whether or not a measure that is devised of a concept really does reflect the concept that it is supposed to be denoting (Bryman and Bell, 2003). In this instance, it is problematic because the demographic proxies used are often poor measures of the constructs they represent. For example, Chapter 2 outlined that the comparison between corporate and individual investors is a poor proxy of sophistication.

In this thesis I adopt a combination of two methodologies depending on the research hypotheses being addressed. One methodology involves the analysis of secondary data where investors' real trading data is analysed to measure the disposition effect and some independent variables. I adopt this methodology because the findings will have stronger ecological validity. This methodology is adopted to test hypotheses 1 - 4 and hypothesis 7. The second methodology involves combining the analysis of secondary data with a cross

sectional design. The cross sectional design involves using an online questionnaire to measure some of the independent variables that cannot be measured in the trading data. Investors were invited to complete the online questionnaire (please refer to appendix 3) and their responses were matched to their trading data. The use of a questionnaire allows for highly specific measures rather than proxies, increasing measurement validity. This methodology is adopted to test hypotheses 5-6 and hypotheses 8-11. Whilst this methodology has not been previously adopted in disposition effect research, it has been used in behavioural finance research by Glaser and Weber (2007). They researched the relationship between overconfidence and trading volume by combining questionnaire data with investors' trading data. This methodology builds on their research.

4.3 Methods

Where the previous section outlined the methodology of the thesis, this final section looks specifically at the methods. It has three subsections; the first reviews the statistical methods of measuring the disposition effect. The second subsection outlines the proxies from the trading data which are used as independent variables in the analysis. The third subsection outlines the independent variables which are measured using the online questionnaire.

4.3.1 Measuring the disposition effect

There are two major methods for calculating the disposition effect; survival analysis (Feng and Seasholes, 2005) and the difference between the proportion of gains realised and

proportion of losses realised (PGR- PLR, Odean, 1998). Whilst Odean’s (1998) method is the predominant method adopted in disposition effect research (Brown et al., 2006, Dhar and Zhu, 2006, Leal et al., 2010), the approach adopted by this thesis is based around survival analysis. A review of each method is outlined next and then a justification for the survival analysis method is presented.

4.3.1.1 PGR PLR

Odean’s (1998) method of calculating the disposition effect analyses an investor’s portfolio on the day that the investor sells a stock to determine whether or not she is inclined to sell a winner or a loser. This method compares the profitability of the stock sold to other stocks held at the same time. The disposition effect occurs when the investor sells stocks at a gain whilst holding a majority of stocks at a loss.

Making this calculation involves several different steps. The first is to classify the stock sold as either a realised gain or realised loss by comparing the purchase price to the sale price. Then, the other stocks in the investor’s portfolio are classified as a paper gain or a paper loss by comparing their purchase price to the daily high or daily low market price, on the day the other stock is sold. A stock is a paper gain when the purchase price is below the market daily low price. A stock is considered a paper loss when the purchase price is above the market daily high price. From this information the proportion of gains realised and proportion of losses realised are determined using these equations:

$$\frac{Realised\ Gains}{Realised\ Gains+Paper\ Gains} = Proportion\ of\ Gains\ Realised\ (PGR) \tag{1}$$

$$\frac{Realised\ Losses}{Realised\ Losses+Paper\ Losses} = Proportion\ of\ Losses\ Realised\ (PLR) \tag{2}$$

The disposition effect is the difference between the PLR and PGR where if the PGR is greater than the PLR, then the disposition occurs. Also the ratio of PGR to PLR is used as a measure of the disposition effect.

4.3.1.2 *Survival Analysis*

Feng and Seasholes (2005) use a methodology based on survival analysis to measure the disposition effect. Survival analysis is a statistical model used in this situation to describe the probability of investors holding stock overtime. The dependent variable in survival analysis is always time and Feng and Seasholes (2005) measure this as the number of trading days a stock is held for, before it is sold. They calculate the disposition effect using only roundtrip transactions which are defined as starting when an investor first purchases a given stock and ending when the stock balance goes to zero (Feng and Seasholes, 2005, p. 312). The disposition effect exists when a significant increase in the conditional probability of holding a stock (relative to the baseline) occurs because a stock is trading at a loss and, when a significant decrease in the conditional probability of holding a stock (relative to the baseline) occurs because a stock is trading at a gain.

Feng and Seasholes (2005) develop two dummy variables to be included in the survival analysis regressions: a trading loss indicator (TLI) and a trading gain indicator (TGI). These are used to indicate whether a stock is trading at a loss or a gain, relative to a reference point, on each day each investor holds or sells a stock. They are incorporated into survival analysis to indicate whether or not they increase or decrease the conditional probability of holding a stock relative to the baseline. For the TLI, if a stock is sold at loss or is trading at a paper loss relative to the purchase price, then it takes a value of 1, otherwise a value of

zero. For the TGI, if a stock is sold at a gain or is trading at a paper gain relative to the purchase price, then it takes a value of 1, otherwise a value of zero. Paper gains and losses are stocks which are held whilst trading at a gain or a loss. They are calculated using the same method as Odean (1998). The TLI and TGI are the independent variables used in survival analysis to determine how the probability of holding stock changes over time, due to stocks trading at a loss and stocks trading at a gain.

Both methods of calculating the disposition effect have shown support for the disposition effect in aggregate (Chen et al., 2007, Feng and Seasholes, 2005, Odean, 1998). However, Odean's method has been critiqued by Feng and Seasholes (2005) because it is not as efficient at calculating differences in the disposition effect at the investor level. Firstly, they show that if the disposition effect is only calculated on the day an investor sells a stock, then the information between buying and then selling a stock is neglected. Secondly, they show that trading frequency and portfolio size can positively correlate and negatively correlate with the PLR-PGR methodology depending on whether the ratio or the difference between the PLR and PGR is used. Finally, they note that the PGR-PLR method can bunch data with statistics frequently being equal to positive one, zero or negative one.

In this thesis, I adopt a survival analysis method to measure the disposition effect for two reasons. Firstly, this thesis investigates susceptibility to the disposition effect using individual investor variables and this method allows better interpretation of this influence. Secondly, the survival analysis method is better suited to the trading data available as investors' portfolio data was not available. This means that the PLR-PGR method is less suitable because it utilises portfolio information to calculate the disposition effect. More

details of the data collected will be outlined in Chapter 5. Subtle changes are made to the survival analysis methodology as outlined by Feng and Seasholes (2005) and these are outlined next.

There are two key differences between the method used in this thesis and that used by Feng and Seasholes (2005). The first difference relates to the definition of when a stock is a gain or a loss. Feng and Seasholes (2005) make two comparisons to determine whether a stock is a gain, loss or breakeven. Breakeven is when both the TLI and the TGI are equal to 0. The first comparison is made when investors are holding a stock and it determines whether the stock was a paper gain, a paper loss or neither. This is achieved by comparing the purchase price to the daily high and daily low market price. The second comparison is made when the stock is sold and it involves comparing the purchase price to the sale price. The problem with this method is that the first comparison is inherently different to the second comparison. In the first comparison there is a chance that the stock will be at breakeven because the comparison is made between an exact figure (the purchase price) and a range (daily high and daily low). In the second comparison there is lower chance that the stock will be determined as a breakeven because the comparison is made between two exact figures (purchase price and the sale price). The difference in measures creates the impression that stocks are often held at a breakeven, yet rarely sold at breakeven. When analysed using survival analysis, this causes a measurement artefact which influences the results. To overcome this problem with the method of analysis, the two comparisons have been made the same. That is, the TLI and TGI are calculated by comparing the purchase price to the daily high and daily low market price for both paper gains/losses (when a stock is held) and actual gains or losses (when a stock is sold).

The second difference between the methods is that they use a parametric survival model and I adopt a semi-parametric model. The essential difference between these models is that a parametric model makes an assumption about the shape of the baseline hazard function and a semi-parametric model does not. In this thesis, hazard refers to the sale of stock by an investor and survival time is the length of time it is held before sold. In survival analysis, the two key concepts are the survival function $S(t)$ and the hazard rate $h(t)$ (sometimes called the hazard ratio), which are defined as:

$$S(t) = \Pr(T > t) \quad (3)$$

$$h(t) = \lim_{\Delta t \rightarrow 0} \frac{\Pr(t + \Delta t > T > t | T > t)}{\Delta t} \quad (4)$$

where \Pr denotes probability, T denotes the random nonnegative variable for a survival time and t is any specific value of interest for the random variable T (Kleinbaum and Klein, 2005, p. 6). The baseline hazard function is the hazard rate that is common to all subjects in an analysis. Feng and Seasholes (2005) use a Weibull function to estimate the baseline hazard function. In doing so they assume that the rate at which stocks are sold follows a Weibull distribution. I use the Cox (1972) model because no assumptions about the shape of the baseline hazard need to be made. The model used in this analysis is defined as:

$$h(t, X(t)) = h_0(t) e^{\{\sum_{i=1}^p \beta_i X_i\}} \quad (5)$$

where $h_0(t)$ is the baseline hazard function and β_i is the regression coefficients estimated from the data. In this analysis there are both fixed covariates (e.g. the investor based variables) and time varying covariates (e.g. the TLI and TGI). The basic model to determine

the disposition effect includes either the TLI or TGI and assessing whether they increase or decrease the hazard rate. The hazard rates are reported instead of the regression coefficients because their interpretation is easier. If a hazard rate is significantly below or above 1, this represents an increase or decrease in the probability of holding, respectively. A hazard rate of 1 means that the predictors have no effect because $e^0 = 1$.

The method of assessing whether a certain variable influences susceptibility to the disposition effect involves interacting it with the TGI and TLI. For example, if the variable gender is investigated to find a difference in the probability of holding losses for men and women, the equation used is:

$$h(t|x) = h_0(t)e^{(\beta_1 TLI + \beta_2 TLI \times Gender + \beta_3 Gender)} \quad (6)$$

where the hazard rate in β_1 represents whether the TLI increases or decreases the conditional probability of holding, relative to baseline. The hazard rate for β_2 represents whether gender decreases or increases the influence of the TLI on the conditional probability of holding, relative to baseline. Finally, β_3 is a control variable to control for the direct influence of gender on the conditional probability of holding, relative to baseline. In this example, it controls for influence that men trade more frequently than women (Barber and Odean, 2001). The multiplication of the hazard rate for β_1 and β_2 provides an estimate of the hazard rate for the conditional probability of holding losses, relative to baseline, after gender has been taken into account. If the variable used in the model is a continuous variable, then I use the same model but the interpretation of the results involves inputting the actual values of the variable. To illustrate how survival analysis is used to interpret the

results for susceptibility to the disposition effect, I will give a hypothetical example. The example is the influence that 'years of experience' has on the probability of holding losses and the model is defined as:

$$h(t|x) = h_0(t)e^{(\beta_1 TLI + \beta_2 TLI \times \text{Years of experience} + \beta_3 \text{Years of Experience})} \quad (7)$$

where the hazard rate in β_1 represents whether the TLI increases or decreases the conditional probability of holding, relative to baseline. The hazard rate for β_2 represents whether years of experience decreases or increases the influence of the TLI on the conditional probability of holding, relative to baseline. β_3 is a control variable to control for the direct influence of years of experience variable on the conditional probability of holding, relative to baseline. If the coefficient for β_1 is -.5, then the hazard rate for the TLI is $e^{(-0.5)} = .6065$. This represents an increase in the conditional probability of holding of approximately 39% ($1 - .6065 = .3935$) due to a stock being at a loss. If the coefficient for β_2 is 0.15, then the hazard rate for $TLI \times \text{Years of Experience}$ is $e^{(0.15)} = 1.1618$. This means that a 1 year increase in years of experience, decreases the conditional probability of holding losses by 16% ($1 - 1.1618 = -.1618$). A 5 year increase in year of experience is estimated as $e^{(0.15 \times 5)} = (e^{(0.15)})^5 \approx 1.1618^5 = 2.1167$. To estimate the conditional probability of holding losses for an investor who has 1 year of experience, I multiply β_1 by $(\beta_2)^1$, which is $.6065 \times 1.1618 = .7046$. To estimate the conditional probability of holding losses for an investor who has 5 years of experience, I multiply the hazard rate β_1 by $(\beta_2)^5$, which is $0.6065 \times 1.1618^5 = 1.2838$. From this analysis, I can estimate how much variance in the conditional probability of holding losses is associated with years of experience. I use this method extensively to

estimate the amount of influence that the dependent variables have on the disposition effect.

This subsection showed the method of measuring the disposition effect. I argued that survival analysis is more suitable than the PGR-PLR method because of the type of data collected. However, I changed the survival analysis method outlined by Feng and Seasholes (2005) in two ways: Firstly, I adopted a Cox model rather than a Weibull model and secondly, I changed the way in which the TGI and TLI are calculated. The last part of this subsection described the survival analysis model and showed how it is used to interpret the influence of independent variables on the disposition effect. The next two subsections focus on these independent variables, with the first describing those collected in the secondary data, and the second describing those collected via an online questionnaire.

4.3.2 Independent variables from the secondary data

This subsection explains how the independent variables are measured through the trading data. The variables measured in this data are sophistication, gender, age and average trade value and stop loss use. The measurement of each variable is elaborated below.

4.3.2.1 *Sophistication*

Section 2.3 presented a review of the proxies used to measure sophistication and it was argued that the best method of distinguishing sophisticated investors from less sophisticated investors was based on whether or not they traded complex financial products. It is possible to make this distinction in the secondary data because there are some investors who are entitled to trade warrants (equity and currency based). To earn this entitlement they must apply through a screening process with the brokerage firm which

involves the appropriateness assessment outlined in appendix 2. If an investor traded warrants it demonstrates that they had successfully completed the screening process. A dummy variable called sophistication was created and it takes the value of one if an investor traded warrants and zero otherwise.

4.3.2.2 Gender and age

The gender of the investor is included in the trading data and it was measured as a dummy variable where females take the value of one and males take the value of zero. The age of the investor was also included in the secondary data as a whole number in years and it was determined on 14/12/2009 (the final date of the trading data).

4.3.2.3 Average trade value

The average trade value has been adopted as a proxy for wealth and research found that investors with a higher average trade value were less susceptible to the disposition effect (Brown et al., 2006, Seru et al., 2010). This variable was calculated from the secondary data by totalling the value of an investor's trades and dividing by the number of trades.

However, the brokerage firm offers an option for investors to automatically reinvest dividends into stock as they are paid. If an investor participates in this scheme, these reinvestment trades will decrease their average trade value. Therefore, these trades are omitted and average trade value was calculated using the following formula:

$$\text{Average Trade Value} = \left(\frac{(\sum V) - (\sum R)}{(Z - Q)} \right) \quad (8)$$

Where V equals the value of each trade, R equals the value of each reinvestment trade, Z is the number of total trades and Q is the number of reinvestment trades.

4.3.2.4 Stop loss strategies

This thesis researches the extent to which stop losses strategies inoculate against the disposition effect. It is possible to identify the adoption of stop loss strategies because each sale trade activated by a stop loss is marked in the data. However there are some limitations with this data. In Chapter 2, I outlined there are two types of stop losses an investor could use to counteract the disposition effect; an ordinary and tracking stop loss. Both of these types of stop losses were available to investors but the data did not stipulate the type of stop loss used. Thus, it was not possible to create a variable that distinguishes the type of stop loss used. Also, the trading data includes only stop losses that were activated. If an investor set and subsequently removed a stop loss before it was activated, this behaviour is not identified in this data.

I use the data about stop losses to create two variables; a stop loss user variable and a stop loss transaction variable. The stop loss user variable distinguishes between those investors who use stop losses (on any of their trades in the data), from those who did not. It is a dummy variable where investors who used a stop loss take the value of one and other investors take a value of zero. The second variable is the stop loss transaction variable. It is a dummy variable where the transactions that involved a stop loss take the value of one and other transactions take a value of zero.

4.3.3 Questionnaire items

This subsection explains the measurement of the variables that needed to be obtained using an online questionnaire. These are experience, a sophistication control variable, dual process theory variables and emotion regulation variables. The method of measuring each of these variables is outlined next.

4.3.3.1 Experience

As outlined in Chapter 2, experience can be measured using two methods: cumulative number of trades or years of trading experience. The years of trading experience variable was measured in the questionnaire via self report data. Investors were asked how many years they have been actively investing in the stock market and were required to enter a whole number (refer to appendix 3). The data measured by this question was used to create the years of experience variable.

The cumulative number of trades could not be directly measured as it is difficult for an investor to report this information. So the data from the years of experience question was combined with trading data to estimate the cumulative number of trades. This variable was estimated using this formula:

$$\text{Estimated cumulative trades} = \left(\frac{(Z-Q)}{3.5} \right) \times Y \quad (9)$$

where Z is the number of total trades, Q is the number of reinvestment trades and Y is the years of experience. The value of 3.5 is included as a denominator because there are approximately three and half years of data in the sample period.

4.3.3.2 Sophistication control variable

The investor sophistication variable outlined previously involved assessing whether investors traded complex financial products. The brokerage firm advised that very few investors traded these securities and it was anticipated that there would be few responses to questionnaires from these investors. Low response numbers meant that this is not a

suitable control variable and another, self rated, sophistication variable was needed. Three self-rated expertise questions were created to control for investor sophistication. These are:

To what extent does your work experience (current and previous occupations) make you skilled at stock market investment?

To what extent does your official education (secondary school, tertiary education, etc) make you skilled at stock market investment?

To what extent does your informal learning make you skilled at stock market investment?

Answers to this question were measured on a four point Likert scale ranging from 1 *not at all* to 4 *a great deal*. A mean value from these questions was taken as a measure of an investor's self reported sophistication level and it is referred to as self rated expertise. A measure of reliability for a scale is the alpha reliability coefficient (Cronbach's alpha). This is a measure of the average inter-item correlation with the lowest acceptable value being 0.6 and a high value being 0.9 (Sapsford, 2007). The alpha reliability coefficient for the self rated expertise measure is 0.6, showing that it just meets the minimal standard.

4.3.3.3 Dual processes theory

After searching for possible methods of measuring individual differences in system 1 and system 2 cognition, two self report measures were identified. These are Pacini and Epstein's (1999) Rational-Experiential Inventory (REI) and Allinson and Hayes' (1996, Hayes and

Allinson, 1994) Cognitive Style Index (CSI). The CSI was developed as a unifactorial measure to unify a plethora of theories about cognitive style (Kozhevnikov, 2007). This measure is orientated towards organisational tasks and research adopting it has focused on differences in cognitive style of managers (Sadler-Smith et al., 2000), managerial research supervisor-student relationships (Armstrong et al., 2004) and entrepreneurs (Allinson et al., 2000). This organisational focus of the CSI makes it ill suited to use for investors as the questions are pointed towards work based scenarios.

The REI is more appropriate than the CSI for this thesis as it was not developed for a specific domain or context. It is a general scale which was developed to measure individual differences in Epstein's Cognitive Experiential Self Theory (CEST) which posits that people process information by two parallel, interactive systems: a rational system and an experiential system (Epstein et al., 1996, p. 391). The REI was developed from the Need for Cognition Scale (NC Cacioppo and Petty, 1982) and was modified to better identify individual preferences in cognitive style (Epstein, 1994, Epstein, 2003, Epstein et al., 1996, Pacini and Epstein, 1999). These modifications involved developing an additional scale to measure experiential cognition, called the Faith In Intuition scale (Epstein et al., 1996). The REI consists of two unipolar dimensions that measure rational and experiential processing. In addition to the main scales, Pacini and Epstein (1999) developed two subscales which separate each main scale into self rated ability and self rated preference. Thus there are four subscales which I refer to as rational ability, rational preference, intuitive ability and intuitive preference. A definition of each of these subscales is offered by Pacini and Epstein who state (1999, p. 974) rational ability "refers to reports of a high level of ability to think logically and analytically" and rational preference "refers to reliance on and enjoyment of

thinking in an analytical, logical manner". Intuitive ability "refers to reports of a high level of ability with respect to one's intuitive impressions and feelings" and intuitive preference "refers to reliance on and enjoyment of feelings and intuitions in making decisions".

When constructing the REI, Pacini and Epstein (1999) tested for convergent validity and discriminant validity by investigating the relationship between it and other self report personality measures and a decision making bias. Discriminant validity indicates the power of the measure to discriminate between persons or situations which theory says should be different. Convergent validity is related to not making discriminations where theory says they should not be any (Sapsford, 2007). The other measures used to validate the REI included the big five personality traits, emotion expressivity, ego strength and the ratio-bias game. The ratio-bias is a situation where uneven probabilities are presented to participants and they have to choose to draw from a tray with 9/100 odds or one with 1/10 odds. It has been found that some people prefer to draw from a tray with 9/100 odds over one with 1/10 odds but few prefer to draw from a tray with 5/100 odds over one with 1/10 odds (Pacini and Epstein, 1999).

Pacini and Epstein (1999) found that the rational scale was strongly associated with positive adjustment (low neuroticism, high ego strength and self-esteem) and conscientiousness, whereas, the experientiality was strongly associated with interpersonal relationships including extroversion, trust, and emotional expressivity. These results suggest strong convergent validity as both scales are related to traits associated with rationality and experientiality. Furthermore, participants who scored low on the rational scale made more errors on the ratio-bias game than those with a high score. In relation to discriminant

validity, Pacini and Epstein (1999) investigated whether the REI makes contributions beyond the big five and whether the subscales add additional descriptive abilities. They concluded that the REI had predictive ability beyond the big five and that both of the scales could predict unique aspects of other self report measures. This supports that the REI has both discriminant and convergent validity.

More recently, Norris and Epstein (2009) have developed a shorter version of the REI. This shorter version of the questionnaire will be adopted because having a lot of questions may deter some investors from participating in the research. Norris and Epstein (2009) found that the 24 item questionnaire (REI-s24) proved to be an apt substitute for the REI (refer to appendix 3). They found that the alpha reliability coefficients for the rational scale and its ability and preference subscales are .83, .75, and .77, respectively. The corresponding figures for the experiential scale and its ability and preference subscales are .83, .78, and .72, respectively.

There has been some debate about whether dual process questionnaires should be a unifactorial or bipolar instrument. Hogkinson and Saddler-Smith (2003a, 2003b) and Pacini et al (1999) argue that the measures are better conceptualised as the latter to reflect dual process theory and present data on scale factor structures to support this argument. Hayes et al. (2003) argue that there is no need for a two dimensional model because a one dimensional model can reflect dual process theories adequately. However, the argument that cognition can be classified as either intuitive or analytical processes is a critique against dual process theory (Keren and Schul, 2009). Furthermore, Norris and Epstein (2009) found a small but positive correlation ($r = .14$, $p < .01$) between the Rational and Experiential scales

in the REI-S24. This suggests that this scale is not unifactorial, because if it was a negative correlation would be expected. Norris and Epstein (2009) argue that the reason for a significant correlation is due to a large sample (N= 2536) and that the rational and experiential scales should be classified as independent.

4.3.3.4 Measuring emotion regulation

When investigating different measures of emotion regulation many different avenues of theory were investigated. An adjacent area of literature to emotion regulation is coping, which has been used to support emotion regulation theory (Gross and Thompson, 2007, Koole, 2009). Coping is defined as the “the behaviors, cognitions, and perceptions in which people engage when actually contending with their life-problems” (Pearlin and Schooler, 1978, p. 5). With this literature there are many different self report measures such as COPE (Carver et al., 1989), Cognitive Emotion Regulation Questionnaire (Garnefski and Kraaij, 2006, Garnefski et al., 2002) and the Mainz-Krohne Coping Inventory (Krohne et al., 2000). A thorough review of the coping literature and measures was conducted by Skinner et al. (2003) and they found that a lack of consensus about core categories slowed progress in this field. Many of the concepts measured by the various coping scales were not supported by a clear theoretical framework which distinguished one concept from another (Skinner et al., 2003). Furthermore, the applicability of the scales to stock market investment was not always possible because the scales were designed to measure coping strategies in relation to highly impactful life events such as the diagnosis of cancer or bereavement of a partner. Lastly, it was difficult to discern whether certain coping strategies would increase or decrease the disposition effect. For these reasons, the coping self report measures were not adopted.

Within the field of emotion regulation, there are self report measurements which distinguish between different methods of emotion regulation (Gross and John, 2003, Labouvie-Vief et al., 2007). Labouvie-Vief's (2003, Labouvie-Vief et al., 2007, Labouvie-Vief and Medler, 2002) research into emotion regulation identifies two different regulatory strategies, which are particularly relevant to decision making biases. The first method of emotion regulation, referred to as affect optimization, involves the maintenance of positive hedonic tone through the amplification of positive affect and dampening of negative affect. The second method of emotion regulation referred to as cognitive affective complexity is the ability to coordinate positive and negative affect into flexible and differentiated structures (Labouvie-Vief and Medler, 2002, p. 571) . However, after contacting the author regarding their use of a self report measure, I was advised not to use it due to poor face value of the items (Labouvie-Vief, 2009).

A method of measuring differences in emotion regulation strategies in a self report format is offered by Gross and John (2003). As outlined in Chapter 3, Gross' (2001) research works on the premise that specific emotion regulation strategies can be differentiated along the timeline of the unfolding emotional response. At the broadest level, Gross (2001) distinguishes between antecedent-focused and response-focused emotion regulation strategies. At a finer level of detail Gross (2001) investigated the influence of two separate emotion regulation strategies; cognitive reappraisal and expressive suppression. Earlier research on these emotion regulation strategies involved an experimental design where participants were instructed to adopt a strategy (Gross, 1998, Richards and Gross, 2000), neglecting individual differences which exist in adopting these strategies. So Gross and

John (2003) developed the Emotion Regulation Questionnaire (ERQ; refer to appendix 3) to measure trait based individual differences in the use of reappraisal and suppression.

On the basis of their model and experimental work, Gross and John (2003) derived the 10-item questionnaire that comprises of 6 items for reappraisal and 4 items for expressive suppression. Gross and John (2003) reported that the six-item reappraisal and the four-item expressive suppression scales were independent in each sample used for the study. This means that individuals who frequently use reappraisal were no more (or less) likely to use expressive suppression than individuals who use reappraisal infrequently. A series of confirmatory factor analyses were used to test these conclusions. The reported alpha reliability coefficient averaged 0.79 for reappraisal and 0.73 for expressive suppression suggesting good internal validity. Also test–retest reliability across 3 months was .69 for both scales suggesting that the measure has good reliability over time. Results on gender differences using the expressive suppression scale revealed that men scored, on average, higher than women.

Gross and John (2003) also tested the convergent validity of the ERQ by testing the relationship between it and other related concepts. They found that reappraisal was related to a coping strategy called reinterpretation and that expressive suppression was negatively related to a coping strategy called venting, suggesting good convergent validity. They also investigated the discriminant validity by testing the relationship between the ERQ and other proven psychological measures including the big five personality dimensions, cognitive ability and social desirability. The results indicated strong discriminant validity, as both of the scales had low correlations with most of the scales of the big five personality

dimensions. Furthermore, the ERQ was not significantly related to cognitive ability or social desirability. These results endorse that the ERQ is measuring a unique psychological construct.

4.4 Conclusion

This chapter justified the methodology chosen in this thesis. In the broadest sense business research can be classified into two epistemological approaches; logical positivism and interpretivism and two ontological approaches; objectivist and social constructionist. Within the behavioural finance paradigm a branch of research approaches research from a logical positivist epistemology and an objectivist ontology. This thesis adopts a logical positivist approach because it aims to contribute knowledge to this paradigm research. The common methodologies within the behavioural finance paradigm are experimental design and analysis of secondary data. I adopted the analysis of secondary data because it offers better ecological validity. The thesis also includes a cross sectional survey design to improve measurement validity for some variables. I argued that the best method of measuring the disposition effect is through survival analysis of trading data because it is more suited to measure individual differences in the disposition effect. I outlined the methods of measuring the independent variables from both the trading data and from an online questionnaire. The next chapter elaborates further on the data. It describes how the trading data was filtered to calculate the disposition effect, how the online questionnaire was administered and shows descriptive statistics of the independent variables.

Chapter 5. Data collection and filtering

The previous chapter gave a justification for the methodology adopted in this thesis. This chapter focuses on the details of how the data was collected and organised for analysis. The first three sections are structured around the types of data collected and the final section offers descriptive statistics about the data. The first section pertains to the investors' trading records and outlines how they were collected and filtered in order to make disposition effect calculations. This section also describes how a purchase price was calculated and how corporate actions were controlled for. The second section outlines the collection of the stock price data from Datastream and how it was combined with the trading data for analysis. The third section covers the questionnaire data. It details how the questionnaire was administered and outlines the number of responses collected. The final section offers descriptive statistics on the data and also conducts tests to establish suitability of the data for survival analysis.

5.1 Trading data

This section explains how the investors' trading records were used to make disposition effect calculations. The first subsection begins by describing the type and amount of trading information that was obtained. Calculating the disposition effect using survival analysis involves determining how long a stock is held and whether or not that stock was trading at a gain or a loss on each day it was held. To do this, I use only roundtrip transactions and the second subsection explains how the trading records were filtered into them.

5.1.1 Trading records

The trading data was obtained from a brokerage firm which offers an execution brokerage service via their website and telephone for UK clients to trade stocks. The core business of the brokerage firm is to provide administration of trading accounts and 72 percent of trades occur via their website. It focuses on the trading of UK shares and UK funds and all prices are quoted in British Pounds (GBP). The brokerage firm has the provision to allow investors to purchase foreign stocks via market makers and a very small group of investors can trade complex products (warrants). The sales manager informed me that the majority of the brokerage firm's clients invested on a part-time basis. Their typical client was middle aged and did not have children living at home. Thus, they had wealth to invest in the stock market due to high income and low expenses. Information about the average age of the UK investor was presented to the sales manager (The International Longevity Centre UK, 2003) and he confirmed that this was reflective of the brokerage firms clients. In this sense the investors used in this research were typical of UK households.

The selection of the trading data was completed by the sales manager at the brokerage firm. The manager selected investors at random from the brokerage firm's database after they had met three criteria; each investor had authorised the brokerage firm that they could be contacted for marketing purposes, each investor needed to have an email address and each investor needed to have completed at least 3 trades over the observation period. The brokerage firm provided trading data for 7,828 investors over the period 04/07/2006 to 14/12/2009. This observation period covers 875 trading days during which the investors completed 395,998 trades. The data contains all of the investors' transactions which were completed in the secondary market through the brokerage firm (refer to appendix 4 for a

summary of the information). Portfolio information, which showed the investors' holdings on the 04/07/2006, was not available.

5.1.2 Developing roundtrip transactions

After the trading data was received from the brokerage firm it was filtered into roundtrip transactions in order to calculate the disposition effect. A roundtrip transaction is defined as the combined trades where an investor has bought and sold the same stock so that their holding balance returns to zero (with a sell trade). There are three rationales for using only roundtrip transactions. Firstly, roundtrip transactions were used by Feng and Seasholes (2005), so using them makes findings from this research comparable to theirs. Secondly, errors may occur when determining an investor's starting position because investor portfolio data was not available. An investor may have purchased a stock prior to the observation period and this could cause error when calculating a purchase price. The use of roundtrip transactions will reduce this error as the same amount of stock is being purchased then sold. Finally, some investors adopt a buy and hold strategy towards some stocks in their portfolio. As will be outlined later, 90,304 trades are associated with buy and hold transactions and this is about 23% of the total trading data. Through using only roundtrip transactions, the analysis considers only those stocks which an investor has decided to sell.

The trading data was manipulated to make it suitable for analysis. I filtered the data so that there were only roundtrip transactions remaining and then calculated an accurate purchase price. This process involved three major steps; roundtrip formation, calculating a reference point and controlling for corporate actions. Here I present a basic overview of each of these

steps but a more detailed explanation is located in appendix 5. The first step involved removing data which was not fit for analysis. This is data which could not be formed into roundtrip transactions (such as investors who did not sell any stock), or data where demographic information was missing. Once this data was removed, I then calculated an investor holding balance based on the purchases and sales that each investor made, in each stock. Roundtrip transactions were identified using the investor holding balance and a unique number was assigned to each one.

The second step involves creating a reference point. Research on the disposition effect research has assumed this to be the purchase price (Odean, 1998). I use a share weighted average purchase price (SWAPP) as a reference point because this changes as subsequent purchases are made within a roundtrip transaction. I measure the disposition effect using only the first sell trade within a roundtrip transaction, because I aim to measure the influence of gains or losses on the decision to first sell a stock. Thus, SWAPP updates when additional purchases are made but does not update when a sale occurs. The formula used to calculate SWAPP is:

$$\text{Share weighted average purchase price} = \frac{\text{cumulative value invested}}{\text{investor stock holding}} \quad (9)$$

where the cumulative value invested refers to the cumulative value in GBP that the investor has purchased in the stock after the completion of each purchase trade within the roundtrip transaction. Investor stock holding refers to the cumulative number of stocks held by the investor after the completion of each trade within the roundtrip transaction.

The third step involved considering the influence that corporate actions have on these roundtrip transactions. The corporate actions of interest are the ones taken by firms that

result in changes to their capital structure and shareholders' holding. The specific corporate actions of interest in this study are rights issues, splits, consolidations and scrip issues. These corporate actions could have two influences on the roundtrip transactions. Firstly, they could influence the price of a stock so that the SWAPP is no longer an accurate reference point. To control for this influence, Datastream's adjustment coefficient was applied to those roundtrip transactions which were influenced by a corporate action. A second influence of corporate actions is that they could alter the investor holding balance, causing roundtrips to not be identified in the trading data. To adjust for this influence, I researched the corporate actions on all of the stocks held by investors over the sample period. I then created a database of the corporate actions which specified the ex date of the corporate action and the terms for the change in stock holding (e.g. split 2 for 1). I used this database to create an artificial trade that represented the change in stock holding that an investor would experience due to the corporate action. This was applied to the trading data that could not be formed into roundtrip transactions. In other words, all data which did not form into roundtrips was adjusted for corporate actions by having artificial trades included. This artificial trade updated both the shareholding balance and share weighted average purchase price in accordance with the corporate action. After this, the trading records were analysed again to ascertain if any further roundtrip transactions could be identified.

Once these three steps were undertaken, the trading data consisted of 66,062 roundtrip transactions made from 172,498 trades. This represents 43.56% of the total trading data collected (refer to Table 5:1 for summary of the number of trades filter from the data at this point).

Table 5:1 Amount of trades filtered into roundtrip transactions

	Number of trades	Percentage of total data
Data received from discount brokerage	395,998	100 %
Data removed because; transactions were a sale without a prior purchase; investor demographic information missing; investors do not sell or investor are too young	77,494	19.57%
Data which is buy and hold transactions	90,304	22.80%
Data which is buy and sell but not roundtrip transactions	55,702	14.07%
Data formed into roundtrip transactions	172,498	43.56%

5.2 Price data

The purpose of this section is to outline the collection of the stock price data from Datastream and how it was combined with the roundtrip data for analysis. The roundtrip data contained 4,085 different stocks for which daily price information is required. Each security is identifiable by its International Security Identification Number (ISIN) and it can be used as a reference in Datastream. However, seven securities in the trading data did not have any ISIN and a further 16 securities could not be located in Datastream despite each having an ISIN. These were removed from the data, leaving 4,062 stocks (please refer to Table 5:2 for the information about the stock type and Table 5:3 for the currency they traded in). All the stocks which traded in foreign currencies were converted them into GBP using Datastream’s conversion tool. This currency conversion tool uses the closing spot rate for currencies from WM/Reuters (2011). The vast majority of the transactions used in the disposition effect calculations involved UK equities (94.68%) with only a small number of stocks being traded in a foreign currency or were of another type (e.g. bonds, funds etc). So

the influence of foreign stocks and other types of financial products on the disposition effect calculations is relatively small.

Table 5:2 The types of stocks traded by the investors

Stock type	Number of stocks
American depository notes	56
Bond	78
Closed end fund	52
Bond convertible	2
Equity	2764
Exchange traded fund	181
Equity warrant	113
Global depository receipt	5
Investment trust	332
Other warrant	31
Bond preference share financial	29
Bond preference share industrial	3
Unit trust	416
Total	4062

Table 5:3 Currencies of securities traded in the data

Currency (Datastream symbol)	Number of stocks
UK pounds (£)	3331
Australian dollar (A\$)	15
Canadian dollar (C\$)	72
Danish krone (DK)	2
Euro (E)	145
Israel shekel (I£)	2
Hong Kong dollar (K\$)	1
Norwegian krone (NK)	6
Swiss franc (SF)	12
Swedish krona (SK)	6
Bangladesh taka (TK)	1
USA dollar (U\$)	468
Japanese yen (Y)	1
Total	4062

The stock price information downloaded from Datastream includes the unadjusted high and low price, the adjusted low and high price and the adjustment factor. The adjusted price

high and low is the daily high and low which has been multiplied by the adjustment coefficient. These prices were compared to the roundtrip transactions which were controlled for corporate actions using the adjustment coefficient. The majority of the trading data were compared to unadjusted stock prices.

The price data and trading were combined to calculate the holding time and the TLI and TGI for each day within each roundtrip transaction. This involved comparing the SWAPP to the daily high and daily low price on every trading day within each roundtrip transaction. When the data was combined, there were 829 roundtrips omitted because accurate price data could not be obtained for them. All of the transactions which involved warrants were also omitted because the thesis wants to ascertain the disposition effect for investors who trade warrants based only on their ordinary stock transactions (Leal et al., 2010, Seru et al., 2010). Furthermore, accurate price data for warrants was very difficult to obtain (Datastream, 2010). Thus, 137 warrant roundtrip transactions were removed. The total number of roundtrip transactions after the trading data and price data were combined is 65,096. These roundtrip transactions were completed by 4,328 investors who made 169,608 trades. Around three quarters of these roundtrips transactions consisted of one buy trade and one sell trade. There are 6,836 roundtrip transactions that contained more than one sell transaction, but as mentioned earlier, the analysis only used information up until the first sale for these roundtrip transactions (refer to Table 5:4 for the number of multiple buy and sell trades within the roundtrip transaction data).

Table 5:4: The buy and sell trades of the roundtrip transactions

Number of trades	Sells						Total
1	2	3	4	5	6+		
49,334	1,770	222	39	5	10	51,380	
(75.79%)	(2.72%)	(0.34%)	(0.06%)	(0.01%)	(0.02%)	(78.93%)	
6,208	1,657	227	57	16	8	8,173	
(9.54%)	(2.55%)	(0.35%)	(0.09%)	(0.02%)	(0.01%)	(12.56%)	
1,705	670	332	76	15	8	2,806	
(2.62%)	(1.03%)	(0.51%)	(0.12%)	(0.02%)	(0.01%)	(4.31%)	
544	287	174	102	35	26	1,168	
(0.84%)	(0.44%)	(0.27%)	(0.16%)	(0.05%)	(0.04%)	(1.79%)	
221	132	112	62	45	28	600	
(0.34%)	(0.20%)	(0.17%)	(0.10%)	(0.07%)	(0.04%)	(0.92%)	
248	161	116	101	92	251	969	
(0.38%)	(0.25%)	(0.18%)	(0.16%)	(0.14%)	(0.39%)	(1.49%)	
58,260	4677	1183	437	208	331	65,096	
(89.50%)	(7.18%)	(1.82%)	(0.67%)	(0.32%)	(0.51%)	(100.00%)	

5.3 Questionnaire data

This section outlines how investors were selected to participate in the research, how the questionnaire data was collected and what differences exist between those investors who were used in the questionnaire analysis from those who were not. Prior to collecting the questionnaire data ethics approval was obtained from The Open University Society for Research on Human Participants (refer to appendix 6). This body advises on, and gives approval for, ethical research practices for all research at the Open University that involves human participants. An aspect of the ethics approval was that the handling and storage of data complied with the Data Protection Act (1998).

Investors were selected to participate in the research before the disposition effect calculations could be made on the trading data. This occurred because the length of time needed to calculate the disposition effect is long and the questionnaire needed to be sent to the investors as quickly as possible after the trading data was collected. The criteria to select investors to participate in the research were based on those investors who were more likely to trade enough to give an accurate disposition effect measure. Investors were selected from the sample data if they met the following criteria:

1. They had sold two different stocks that had a prior purchase
2. There was demographic information available for them
3. They were 19 years old or over

This left 4,125 investors who were used as a sample for this research. A list of these investors' numbers was given to the discount brokerage who then administered the invitations to participate in the research. The method of inviting these investors to participate in the research is outlined next.

Each investor was posted a letter on 01/02/2010 by the discount brokerage firm. This letter informed the investor of the research and also gave them the opportunity to withdraw participation if they chose (refer to appendix 7). If an investor chose to withdraw participation, they could contact the discount brokerage firm and would receive no further communication. On 17/02/2010 the investors were emailed a link to the survey. This link directs the investor to the online survey hosted by Survey Monkey and contained each investor's ID. The link enabled the investor's response to the survey to be matched with the trading records. Finally on 03/03/2010, a reminder email was sent to investors asking them to participate in the research again, if that had not done so already.

The questionnaire was split into a short and a long version to improve response numbers. The short version consisted of 10 questions, at the end of which an investor could choose to answer a further 29 questions in the long questionnaire. There were 586 responses to the questionnaire, with 97 investors choosing to complete the short version of the questionnaire and 489 investors choosing to complete the long version. Due to a technical error with the web link, 206 of the responses to the long questionnaire could not be matched to their trading data. When the responses to the questionnaire were matched with the trading data 21 investors had not completed any roundtrip transactions so they could not be included in the analysis. Finally, 1 investor was excluded as an outlier. The outlier was identified by looking at the 5 highest scores and 5 lowest scores on each scale. It was found that one investor had the lowest score for both scales of the Emotion Regulation Questionnaire. After further investigation it was found that this investor had answered only "1" for an entire section of the online questionnaire. For this reason, this investor's data was not included in the analysis. This left a sample of 261 investors for the analysis of the questionnaire data.

5.4 Descriptive statistics of independent variables

The purpose of this section is to provide descriptive statistics about independent variables. It also tests whether the independent variables are suitable for survival analysis. Survival analysis differs from other forms of regression in that the independent variables are not required to have a normal distribution. The suitability of variables for survival analysis is based on whether or not the variable meets the proportional hazard assumption (Cleves et al., 2008, Kleinbaum and Klein, 2005). It is helpful to adjust variables to aid with the

interpretation of results by ensuring that the range of values is not excessive and the lowest value is a relevant starting point. Below descriptive statistics and tests of the proportional hazard assumption are outlined. The first subsection outlines these principals for the variables obtained from the trading data and following subsection discusses the variables obtained from the questionnaire.

5.4.1 Demographic variables from trading data

The variables of interest which were obtained from the trading data are gender, age and average trade value, sophistication, stop loss users and stop loss transactions. The descriptive statistics pertaining to these variables are outlined in the second column of Table 5:5. The table shows that there are; 6,040 stop loss transactions, representing 9.28% of the total data, 847 female account holders representing 19.57% of the trading data sample, 1,027 stop loss users representing 24.23% of the sample and 79 investors were sophisticated (traded warrants) representing 1.83% of the sample. The average age of the investor is 51.65. To interpret the influence of this variable it is necessary that the variable begins at a realistic value (Cleves et al., 2008). For this reason, 18 was subtracted the investors' age to centre the variable around the youngest person. Then it was divided by 10 to illustrate what a difference of 10 years would have on the disposition effect. The average trade value per investor is £2,163.20.

A comparison of the demographic variables between the investors who are included in the questionnaire analysis and those who are not, is outlined in columns 3 and 4 of Table 5:5. Column 5 shows the results for testing the significance between the two values. A Pearson Chi-square test was used for the number of stop loss transactions, gender, stop loss user and sophistication because these are dummy variables. A student t-test was adopted for

age because the distribution of this variable was close to normal. A Wilcoxon Rank Sum test was used for average trade value, mean number of trades per investor and number of roundtrip transactions per investor because the distributions of these variables were skewed. There are some significant differences between the group of investors who are used in the questionnaire analysis and those who are not. Firstly, there is a higher proportion of male investors in the questionnaire data. This could be due to some female investment accounts being managed by a husband and therefore the female investors opting not to respond to the survey. Another difference is that the investors used in the questionnaire analysis tend to use stop losses more often, and trade more frequently, than the investors not included. This may be related to less female respondents as research has found that men trade more frequently than women (Barber and Odean, 2001). Another possible reason is that the selection criteria included only those who had sold twice. This will increase both the number of trades made and the number of stop losses used. Finally, there is a slight difference in the average age of the investor, with the investors being used in the questionnaire analysis being slightly older, on average, than those investors not included. Although this difference is significant, the size of the difference is small in relative terms.

Overall, there are some significant differences between the group of investors who are included in the questionnaire sample and the group of investors not included. These differences are number of stop losses users, trading frequency, gender and age. Some research has found that age, gender and trading frequency can decrease the disposition effect (Dhar and Zhu, 2006, Feng and Seasholes, 2005, Shu et al., 2005). If these variables have a large influence at decreasing the disposition effect, it is possible that the

questionnaire sample will exhibit less disposition effect than other investors. Also there might be less variance in disposition effect for the questionnaire sample, reducing the ability of independent variables to predict differences in the disposition effect. For this reason, analysis is conducted on whether or not the questionnaire sample exhibits less disposition effect than the other investors. This analysis is outlined in section 6.1 in chapter 6.

Table 5:5 Comparison between investors included in the questionnaire analysis and those who are not

	Total investors	Responded to questionnaire	Did not respond to questionnaire	Significance tests
Number of investors	4,328	261	4,067	
Number of roundtrip transactions	65,096	4,193	60,903	
Number of stop loss roundtrip transactions (Percentage of group)	6,040 (9.28%)	555 (13.23%)	5,485 (9.01%)	p< .01 ^a
Number of female accounts (percentage of group)	838 (19.57%)	29 (11.11%)	819 (19.99%)	p< .01 ^a
Number of stop loss users (percentage of group)	1,027 (23.73%)	67 (25.67%)	960 (23.60%)	p=.447 ^a
Number of investors who trade warrants (percentage of group)	79 (1.83%)	7 (2.68%)	72 (1.77%)	p=.286 ^a
Mean age per investor	51.65	53.04	51.56	p= .049 ^b
Mean average trade value per investor	£2163.20	£ 2174.05	£1994.19	p= .110 ^c
Mean number of trades per investor	70.72	81.72	70.02	p< 0.01 ^c
Mean number of roundtrips per investor	15.04	16.07	14.97	p< 0.01 ^c
a= Pearson Chi-square test b= Students T-test c= Based on Wilcoxon Rank Sum test				

When using survival analysis it is necessary to consider whether the variables violate the proportional hazard assumption (Cleves et al., 2008, Kleinbaum and Klein, 2005). A time dependent covariant is any variable which changes in value over time and inherently

violates the proportional hazard assumption (Kleinbaum and Klein, 2005). In this analysis, there are both time dependent variables and time independent variables. The TLI and TGI are time dependent variables because a stock moves in and out of profit over time. The investor based variables are interacted with the TLI and TGI making the interaction terms also time dependent variables. These variables do not need to be tested for the proportional hazard assumption and an extended Cox model is adopted because it allows for the inclusion of time dependent variables. However, the investor based variables are also included as control variables and in this situation they are time independent variables. Although I do not interpret the influence of these control variables, it is still necessary to test whether these variables meet the proportional hazard assumption.

The proportional hazard assumption can be tested using graphical methods and numerical significance tests (Kleinbaum and Klein, 2005). Although the latter is more objective, it is less suitable to this data set because of the high number of observations ($N = 65,096$). This can cause tests to report significant results when only small violations to the proportional hazard assumption occur (Kleinbaum and Klein, 2005). There are two graphical tests of the proportional hazard assumption; one graphical test involves graphing the log (-log) plot of the survival function over the log of analysis time and this is suitable for dummy variables. The proportional hazard assumption is shown to hold when the lines are parallel to each other (Kleinbaum and Klein, 2005). The other graphical test of the proportional hazard assumption involves running a survival analysis model, then obtaining scaled Schoenfeld (1982) residuals and graphing these over analysis time. If the estimated line is straight then the proportional hazard assumption is met.

The proportional hazard was tested for gender, sophistication (measured by investors who trade warrants), stop loss users and stop loss transactions using log (-log) plots of the survival function over log analysis time (refer to Figure 5:1, Figure 5:2, Figure 5:3 and Figure 5:4). These graphs show the proportional hazard assumption holds for these variables as the lines are mostly parallel.

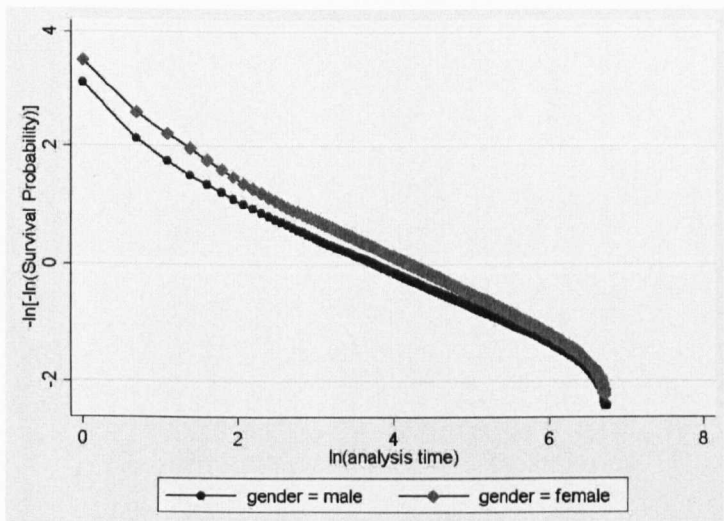


Figure 5:1 Test of the proportional hazard assumption for gender

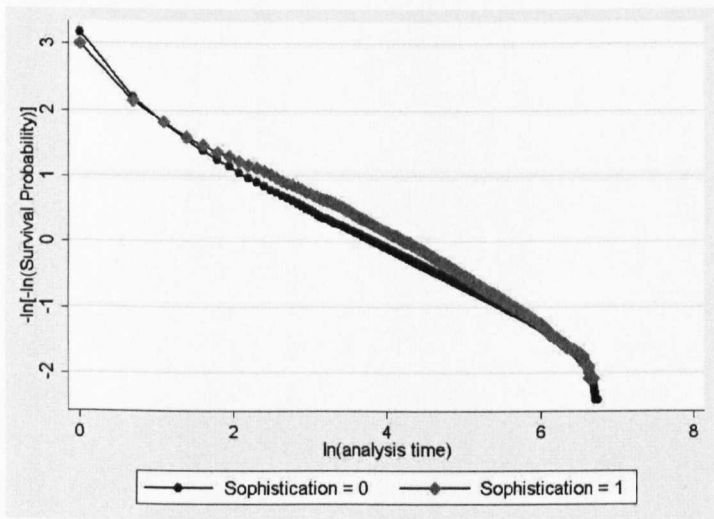


Figure 5:2 Test of the proportional hazard assumption for sophistication

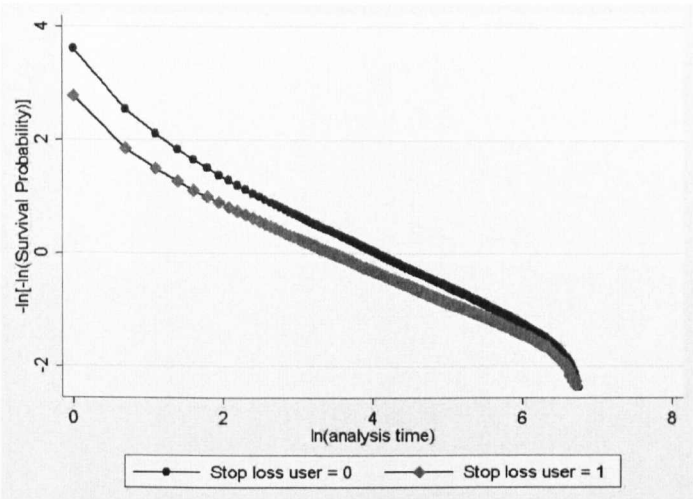


Figure 5:3 Test of the proportional hazard assumption for stop loss user

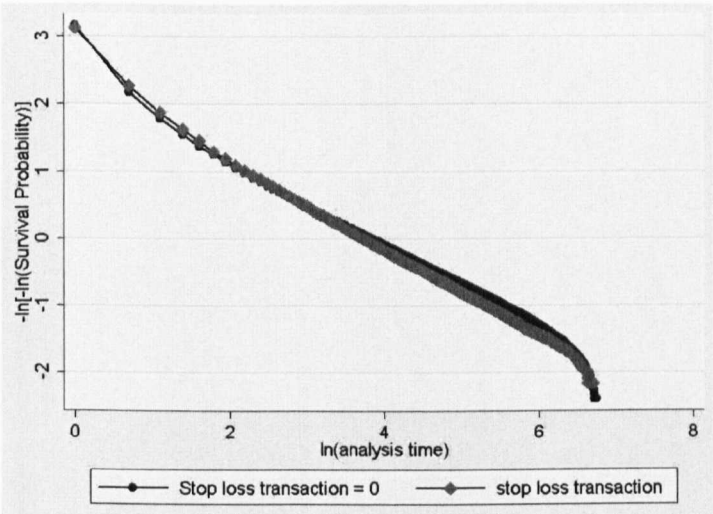


Figure 5:4 Test of the proportional hazard assumption for stop loss transactions

Age and average trade value are continuous variables so the proportional hazard assumption is tested by graphing scaled Schoenfeld residuals over analysis time (refer to Figure 5:5 and Figure 5:6). If the estimated line is straight then the proportional hazard assumption is met. The test of the proportional hazard assumption for age shows that there is a slight violation at the start of the analysis time. However, for average trade value, the line is mostly straight and there is no violation of the proportional hazard assumption. To control for the violation of the proportional hazard assumption by age, an additional control

variable was created by interacting the log of analysis time with age. When this control variable was included in the analysis, age complies with the proportional hazard assumption (refer to Figure 5:7). Thus, when age is used in the analysis, this control variable is also included to correct for the proportional hazard violation.

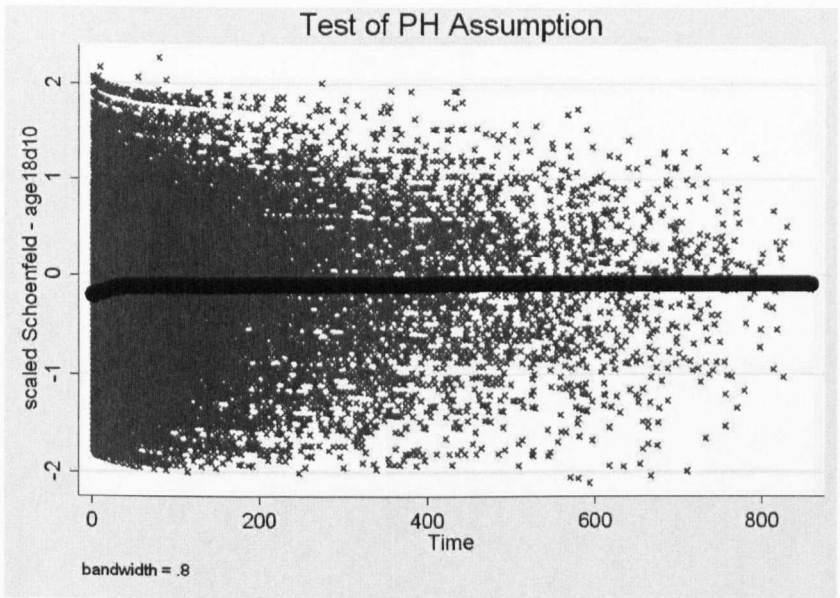


Figure 5:5 Test of the proportional hazard assumption for age

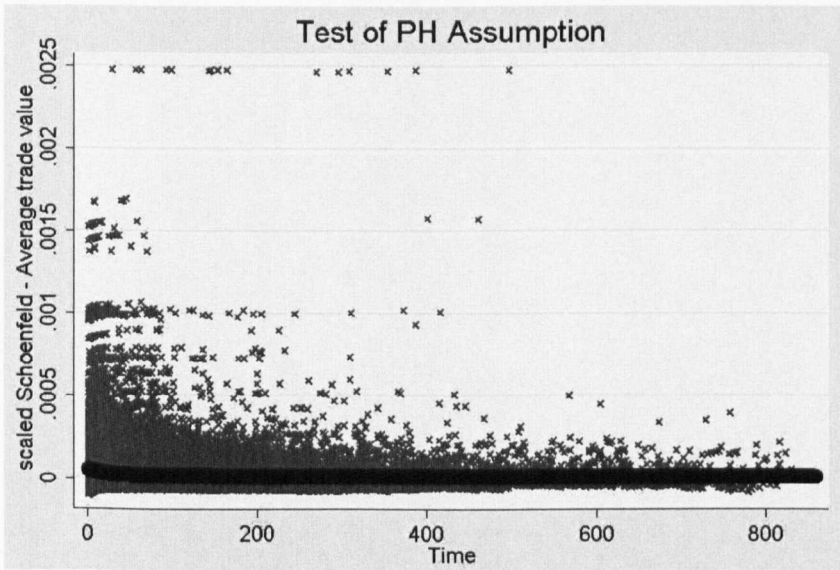


Figure 5:6 Test of the proportional hazard assumption for average trade value

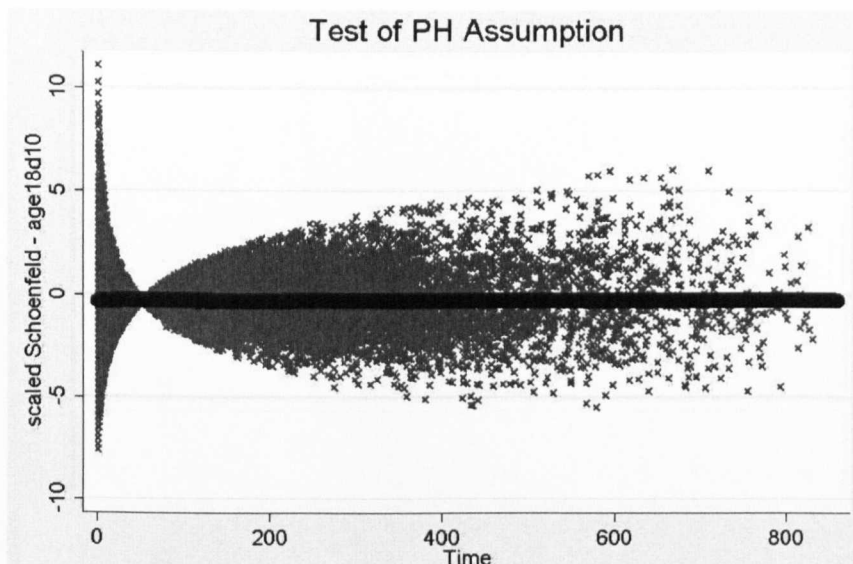


Figure 5:7 Test of the proportional hazard assumption for age with age log time control variable

5.4.2 Questionnaire data

The items measured in the questionnaire data are the Emotion Regulation Questionnaire (ERQ), the Rational-Experiential Inventory (REI), experience, and self-rated expertise. Most of these items had a low range of values and began at a realistic value so did not require any transformation. However, there were two aspects of the questionnaire data which required further attention. Firstly, when the analysis was conducted using the two experience variables, a transform was required to obtain significant results (these results will be outlined in further detail in Chapter 6). Thus, estimated trading frequency and years of trading experience were both altered using a log transformation (refer to Figure 5:8 and Figure 5:9 for the distribution of these variables after the transformation). Secondly, there appears to be some bias with in the distribution of answers to the rational scale and subscales of the REI. The rational scale and rational ability subscale are slightly negatively skewed with more investors measuring above the mean (refer to Figure 5:10 and Figure

5:11). However, the rational preference scale is less negatively skewed with a large group of investors measuring very close to the mean (refer to Figure 5:12). This suggests that there may be some social desirability bias with the rational ability scale.

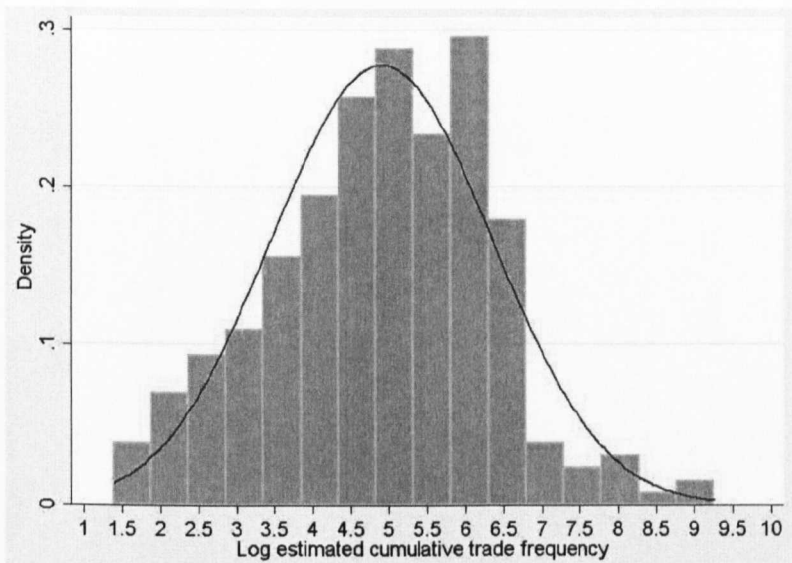


Figure 5:8 Distribution of log estimated trading frequency

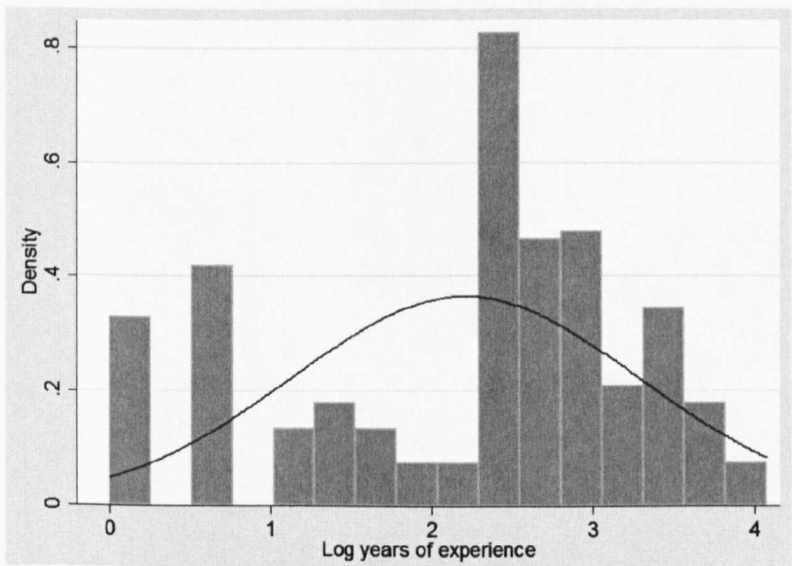


Figure 5:9 Distribution of log years of experience

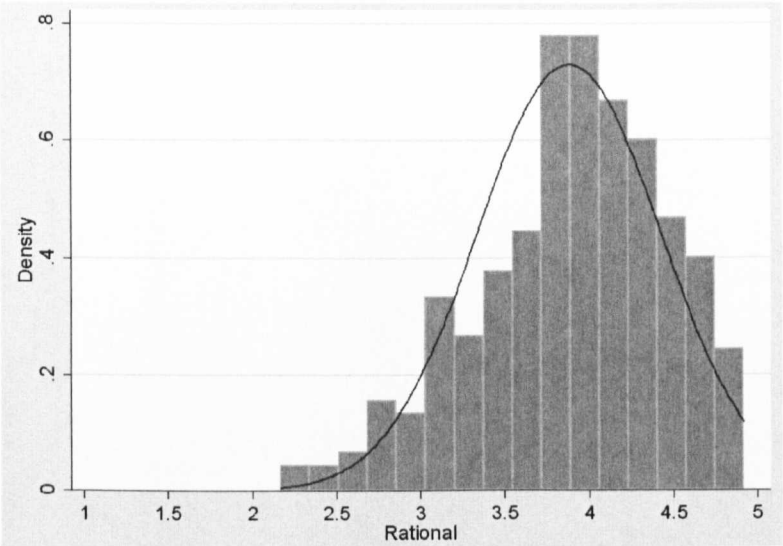


Figure 5:10 Distribution of responses to the rational scale

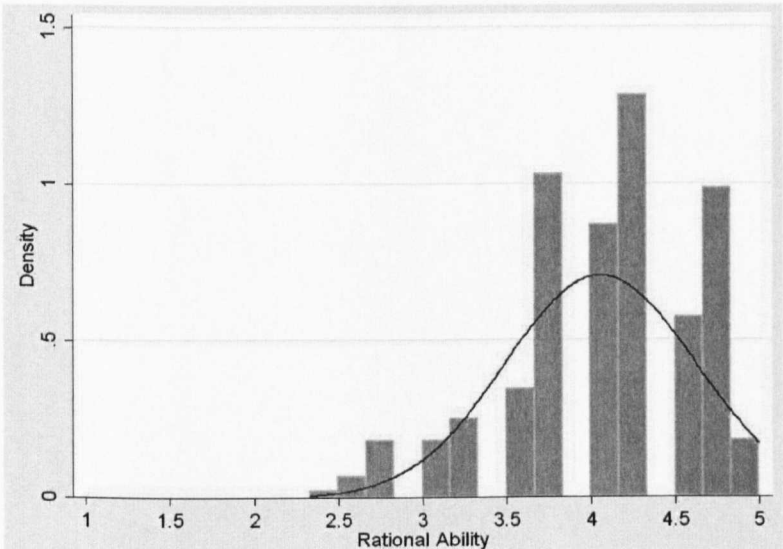


Figure 5:11 Distribution of responses to the rational ability subscale

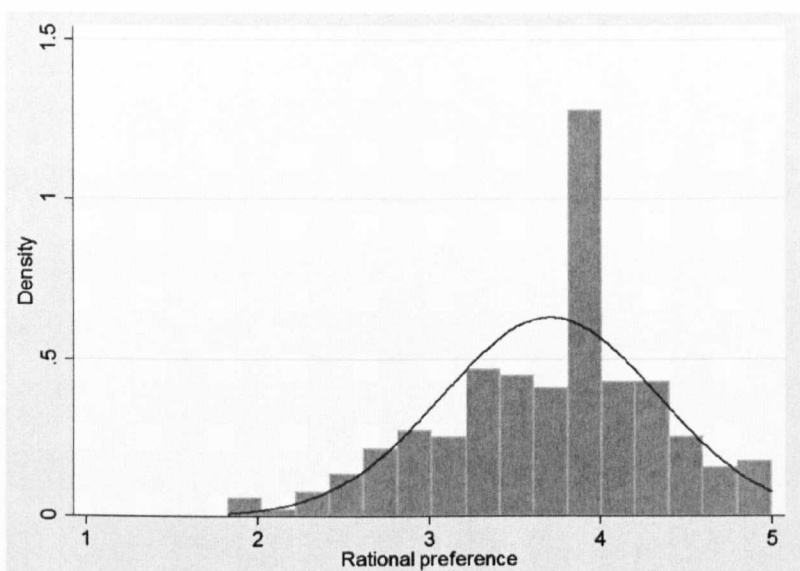


Figure 5:12 Distribution of responses to the rational preference subscale

The relationship between the questionnaire items was investigated using Pearson correlations for the continuous variables (refer to Table 5:6) and students t-test for the dummy variables (refer to Table 5:7 & Table 5:8). The average trade value variable had a skewed distribution, so Spearman correlations and Wilcox rank sum tests are reported for this variable. There are some minor correlations in the table which are to be expected. Firstly, reappraisal is positively correlated with the rational scale ($r=0.16$, $p<.01$) and the expressive suppression scale is negatively correlated with the experiential scale ($r= -0.17$, $p<.01$). This suggests that investors who reappraise are more inclined to use rational decision making processes and investors who suppress are less likely to trust intuitions. A bigger significant positive correlation exists between self-rated expertise and the rational scale ($r= 0.28$, $p<.01$) and rational subscales. This shows that those investors who rate themselves as having high expertise also rate themselves as being rational. This correlation concurs with the social desirability bias indicated in the distribution scores of the rational scales. Epstein and colleges (Epstein et al., 1996, Pacini and Epstein, 1999) have found that the rational scale was associated with ego strength suggesting that high self confidence may

be associated with this scale. Secondly, there is a negative relationship between age and the experiential scale ($r = -.28, p < .01$) and experiential subscales. This suggests that as investors get older they have less trust in their intuitive judgements. Also, there is a positive relationship between age and average trade value ($r_s = .24, p < .01$) which suggests that older investors trade in larger values. This supports the argument presented in Chapter 2, that older investors tend to be wealthier. Finally, there is a significant negative correlation between the rational and experiential scale ($r = -0.12, p < .05$), which differs to previous research that found a positive correlation (Norris and Epstein, 2009). The rational and experiential scale will still be treated as unifactorial in this analysis because this correlation is relatively small.

Differences in questionnaire responses based on gender and stop loss user are outlined in Table 5:7 and Table 5:8. These tables show whether there are any differences in the other independent variables for females compared to males and for stop loss users compared to other investors. The tests for stop loss users illustrates that there are no significant differences for most of the independent variables. However, there is a significant difference between stop loss users and non-stop loss users in terms of years of investment experience. Stop loss users tend to have less experience than non-stop loss users, suggesting that stop loss use is distinct from experience. For gender, women score significantly lower on the rationality scales, rationality subscales and self rated expertise. The difference in rationality scales based on gender has been found in previous research using this measure (Norris and Epstein, 2009). Furthermore, other research has argued that women are less overconfident than men in investing (Barber and Odean, 2001) and the difference in self-rated expertise complies with these findings. This thesis will test for gender differences in the disposition

effect in order to assess whether gender should be controlled for when analysing other variables.

Table 5:6 Pearson correlations and spearman correlations of dependent variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Reappraisal	M: 4.61 SD: .86												
2. Suppression	-0.06	M: 3.85 SD:1.10											
3. Rational	0.16**	-0.02	M:3.88 SD: .55										
4. Experiential	-0.02	-0.17**	-0.12*	M:3.24 SD: .55									
5. Rational ability	0.12	0.01	0.90**	-0.11	M: 4.06 SD: 56								
6. Rational preference	0.17**	-0.04	0.92**	-0.12	0.66**	M:3.71 SD: .63							
7. Experiential ability	0.01	-0.19**	-0.04	0.90**	-0.01	-0.06	M:3.33 SD: .57						
8. Experiential preference	-0.04	-0.12	-0.18**	0.92**	-0.19**	-0.15*	0.65**	M:3.16 SD: .63					
9. Average trade value ^a	-0.05	0.09	0.08	-0.09	0.04	0.08	-0.10	-0.07	M: 1994 SD:3010				
10. Log Estimated cumulative trades	-0.02	0.09	0.01	-0.17**	0.05	-0.03	-0.20**	-0.12	0.11	M:4.90 SD:1.44			
11. Age	0.01	0.06	-0.10	-0.28**	-0.13*	-0.06	-0.30**	-0.22**	0.24**	0.40**	M:3.50 SD:1.35		
12. Self rated expertise	0.11	0.00	0.28**	-0.07	0.23**	0.27**	-0.02	-0.10	0.15*	0.19**	0.04	M:2.30 SD: .61	
13. Log years of experience	-0.08	0.11	-0.02	-0.24**	0.00	-0.04	-0.26**	-0.19**	0.17**	0.79**	0.47**	0.19**	M:2.20 SD:1.10

^a= Spearman correlation, M= Mean, SD= Standard Deviation, * significant at 95% confidence level | ** significant at 99% confidence level

Table 5:7 Comparisons of dependent variables according to stop loss users

Measure	Mean of non -stop loss users N= 194	Mean of stop loss users N= 67	Significance of the t-test
Reappraisal	4.61	4.57	p= 0.700
Suppression	3.85	3.83	p=0.893
Rational	3.90	3.81	p= 0.227
Experiential	3.22	3.31	p=0.252
Rational ability	4.08	4.00	p=0.331
Rational favourability	3.73	3.62	p=0.225
Experiential ability	3.32	3.36	p= 0.636
Experiential favourability	3.13	3.26	p= 0.118
Average trade value ^a	2026	1901	p= 0.515
Log estimated cumulative trades	4.66	5.10	p= 0.176
Age (minus 18 divided by 10)	3.55	3.38	p= 0.421
Self rated expertise	2.33	2.21	p= 0.196
Log years of experience	2.28	1.95	p= 0.028
^a = a Wilcox rank sum test			

Table 5:8 Comparisons of dependent variables according to gender

Measure	Mean of female investors (N= 28)	Mean of male investors (N=233)	Significance of the T-test
Reappraisal	4.60	4.60	p= 0.816
Suppression	3.57	3.88	p= 0.160
Rational	3.69	3.90	p= 0.047
Experiential	3.36	3.23	p=0.230
Rational ability	3.86	4.08	p=0.048
Rational favourability	3.52	3.73	p=0.096
Experiential ability	3.47	3.31	p= 0.160
Experiential favourability	3.25	3.15	p= 0.428
Average trade value ^a	1513	2051	p= 0.739
Log estimated cumulative trades	4.66	4.93	p= 0.354
Age (minus 18 divided by 10)	3.60	3.49	p= 0.692
Self rated expertise	2.02	2.33	p= 0.012
Log years of experience	2.23	2.00	p= 0.300
^a = a Wilcox rank sum test			

Finally, the proportional hazard assumption was tested for all of the variables in the questionnaire data. As these measures are all continuous variables a graph of scaled Schoenfeld residuals over time is used to assess the proportional hazard assumption. If the estimated line is straight then the proportional hazard assumption is met. The results indicate that the proportional hazard assumption holds for reappraisal, expressive suppression, the rational scale, the experiential scale, self rated expertise, log estimated cumulative trades and log years of experience (refer to Figure 5:13 to 5:19; the rational and experiential subscales are not included for brevity).

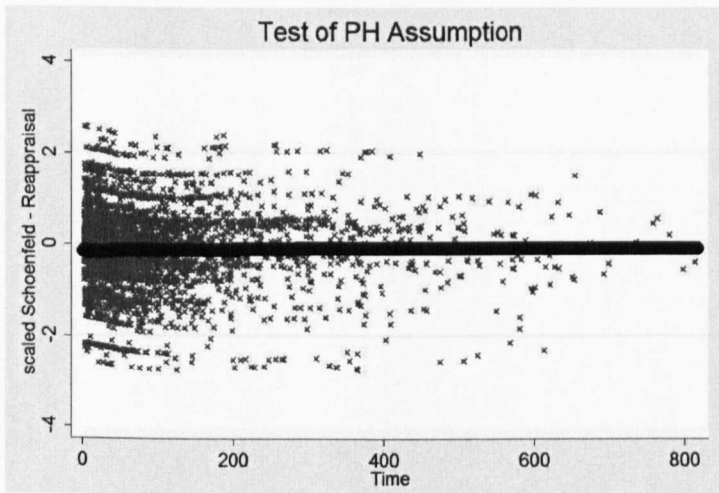


Figure 5:13 Test of the proportional hazard assumption for reappraisal

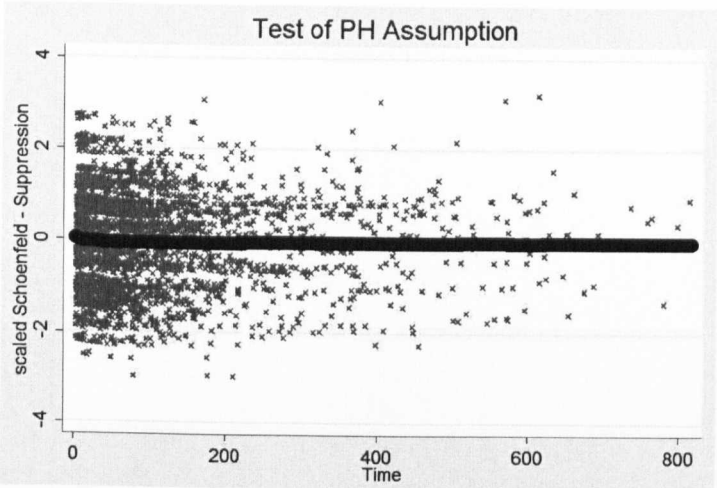


Figure 5:14 Test of the proportional hazard assumption for expressive suppression

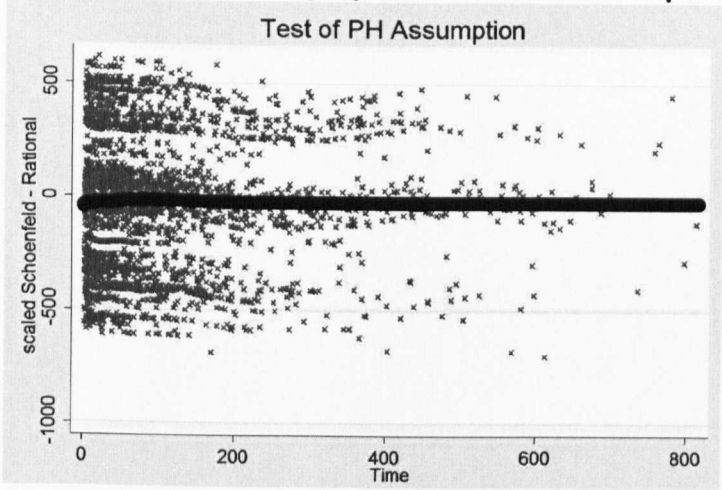


Figure 5:15 Test of the proportional hazard assumption for the rational scale

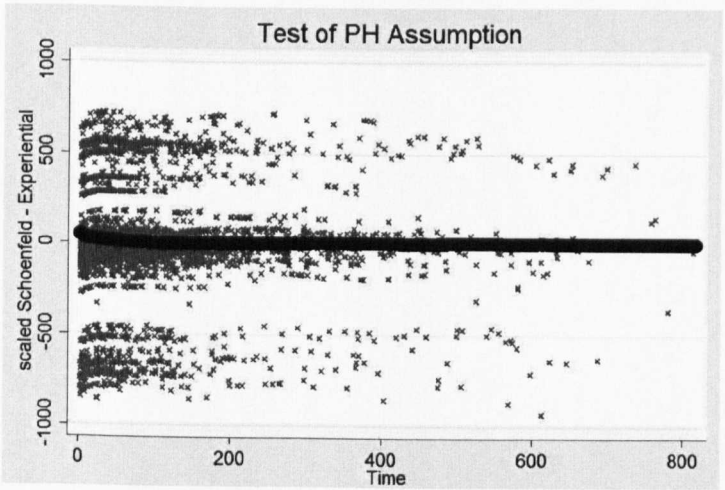


Figure 5:16 Test of the proportional hazard assumption for the experiential scale

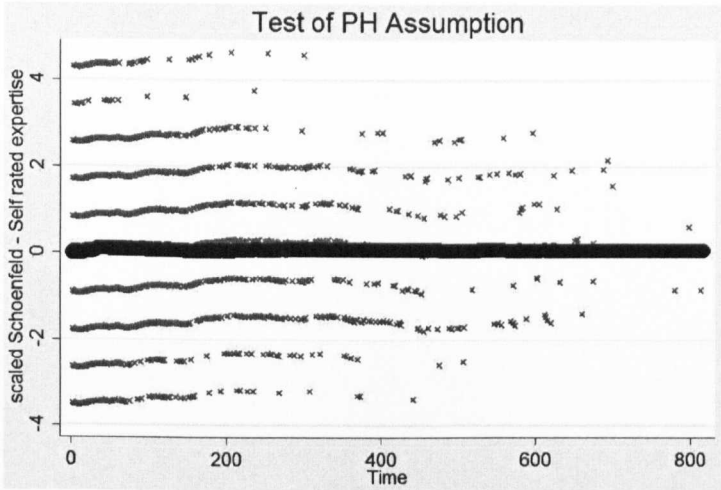


Figure 5:17 Test of the proportional hazard assumption for self rated expertise

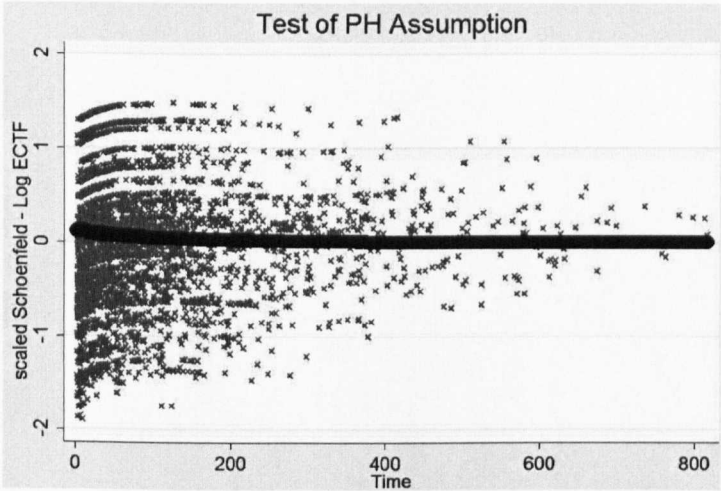


Figure 5:18 Test of the proportional hazard assumption for log estimated cumulative trades

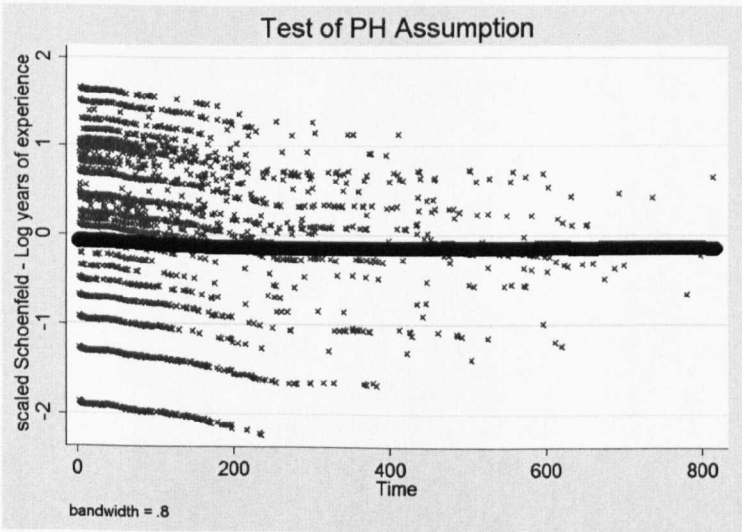


Figure 5:19 Test of the proportional hazard assumption for log years of experience

5.5 Conclusion

This chapter described how the data was collected and filtered for analysis purposes. This trading data was combined with price data to create the TLI and TGI. The chapter also described the collection of the questionnaire data and then offered descriptive statistics of the variables. It found that most variables had a range which was suitable for survival analysis but a log transform was required for estimated cumulative trades and years of experience. It also tested the suitability of the dependent variables for survival analysis based on the proportional hazard assumption. It was found that age was the only variable which violated the proportional hazard assumption. For this variable an additional control variable was created which involved interacting age with log time. When an interaction of age with log time was also included in the regression, age complied with the proportional hazard assumption. The next two chapters outline the findings for the thesis, with Chapter 6 focusing on the demographic variables and Chapter 7 focusing on the psychological variables. As the results are outlined, a critical reflection on the significance and meaning of these results is discussed.

Chapter 6. Findings for the demographic variables

The preceding chapters outlined the literature review, research questions, hypotheses methodology and data for this thesis. The purpose of this chapter is to report the findings which pertain to the hypotheses outlined in Chapter 2. Specifically, it outlines findings for investor susceptibility to the disposition effect based on the demographic variables measured in the trading data and the questionnaire. As each finding is presented, I compare the results to other findings in the literature and outline how this thesis makes a contribution to knowledge. The information is structured around the order of the hypotheses outlined in Chapter 2. The first section outlines the findings for the disposition effect in aggregate. The second section outlines how susceptibility to the disposition effect is predicted by sophistication, gender, age and average trade value, years of experience, estimated cumulative trades and stop loss strategies. The final section combines all of the investor based variables to estimate the amount of variance in the disposition effect that these variables can explain.

6.1 Findings for the disposition effect in aggregate

The first hypothesis outlined in Chapter 2 predicted that the disposition effect would occur for this sample of UK investors. To test this hypothesis survival analysis was conducted for the TLI and TGI to determine whether each variable would influence the conditional probability of holding a stock, relative to baseline. The results are presented in hazard rates ($h(t)$) and a hazard rate which is significantly above 1 represents a decrease in the

probability of holding (or increase probability of selling), relative to baseline, and a hazard rate which is significantly below 1 represents an increase in the probability of holding (or a decrease in the probability of selling), relative to baseline. Regression 1 and regression 2 in Table 6:1 shows the influence of the TLI and TGI, respectively. The hazard rate for the TLI is significantly below 1 ($h(t) = .5781$, $p < .01$) indicating that the probability of holding stocks increases by 42.19% when trading at a loss, relative to baseline. The hazard rate for the TGI is significantly above one ($h(t) = 1.6966$, $p < .01$) indicating that the probability of holding stocks decreases by 69.66% when trading at a gain, relative to baseline. These findings support hypothesis 1 and it is concluded that the disposition effect occurs in this sample of UK stock market investors.

Research on the disposition effect has shown that individual investors are prone to this bias throughout the world. In particular the disposition effect occurs in the USA (Odean, 1998), China (Chen et al., 2007, Feng and Seasholes, 2005), Taiwan (Barber et al., 2007, Shu et al., 2005), Israel (Shapira and Venezia, 2001) Finland (Grinblatt and Keloharju, 2001) Australia (Brown et al., 2006) France (Booell-Gunesh et al., 2009) Portugal (Leal et al., 2010) and Germany (Weber and Welfens, 2008). A contribution to knowledge made by this thesis is to show that the disposition effect also occurs for individual investors in the UK, a country which has not previously been researched. Although this research used a similar methodology to research on the disposition effect in China (Chen et al., 2007, Feng and Seasholes, 2005), it is difficult to compare the results. Cosmetically, there are a few differences in the reported hazard rates. Firstly, the hazard rate for TLI is lower in this research. Feng and Seasholes (2005) reported the hazard rate for the TLI as 0.6321, and Chen et al., (2007) reported it as 0.653. Secondly, the hazard rate for the TGI is lower than

other results. Feng and Seasholes (2005) reported the hazard rate for the TGI as 4.3842 and Chen et al (2007) found it to be 1.861. Why this occurs is difficult to determine. A possible reason for the difference in the findings is the slight difference in the methodology outlined in Chapter 4. When the analysis was conducted using Feng and Seasholes (2005) method the hazard rate for the TLI equals .8143 and the hazard rate for the TGI equals 2.5085. Another reason is that the Chinese investors are investing in a very different market. This market might have higher volatility than the UK market and it may have predominantly been a bull or bear market. Another reason is that the investors may have a different attitude to investing which could cause different results. In particular, Feng and Seasholes (2005) researched only investors new to investing which could explain the very high TGI hazard rate they found. Overall, it is difficult to pinpoint an exact reason for the differences in the disposition effect between the two countries. However, investigating differences in the disposition effect between countries could be an avenue to explore in future research and it would need to consider using the same methodology, the influence of different market conditions, the influence of different trading rules and the influence of different investment attitudes between countries.

Table 6:1 Findings for the disposition effect

	Reg 1	Reg 2
TLI (Z-stat)	.5781*** (-63.39)	
TGI (Z-stat)		1.6966*** (64.88)
*** - significant at 1% level		

It is also worth analysing the level of the disposition effect exhibited by the group of investors who are included in the questionnaire analysis (N=261). It is possible that these

investors may be somewhat more or less prone to the disposition effect than other investors. The amount of disposition effect exhibited by the questionnaire investors is outlined in Table 6:2. The hazard rate for the TLI is significantly below 1 ($h(t) = .5462$, $p < .01$) indicating that the probability of holding stocks increases by 45.38% when trading at a loss, relative to baseline. The hazard rate for the TGI is significantly above one ($h(t) = 1.9054$, $p < .01$) indicating that the probability of holding stocks decreases by 90.54% when trading at a gain, relative to baseline. These findings suggest that the investors in the questionnaire data sell gains sooner than investors not included in the questionnaire data because the estimated hazard rate for the TGI of the questionnaire investors ($h(t) = 1.9054$, $p < .01$) is higher than the other investors ($h(t) = 1.6966$, $p < .01$).

Table 6:2 Findings for the disposition effect of the investors used in the questionnaire analysis

	Reg 1	Reg 2
TLI (Z-stat)	.5462*** (-18.13)	
TGI (Z-stat)		1.9054*** (20.54)
*** - significant at 1% level		

I conducted further analysis to investigate whether there is a significant difference in the level of disposition effect exhibited by the investors in the questionnaire data. A questionnaire investor variable was created and it took the value of one for all the investors in the questionnaire sample and took the value of zero for all other investors. This variable was interacted with the TLI and TGI and then survival analysis was conducted to assess the influence that this variable had on the disposition effect. The results outlined in regression 1 and regression 2 of Table 6:3 show the difference in the disposition effect for the

questionnaire investors. The influence of the questionnaire investor interacted with the TLI is not significant ($h(t) = .9922$, $p = .819$) showing that the questionnaire investors do not differ from other investors in their probability of holding losses, relative to baseline. The influence of questionnaire investor interacted with the TGI is significantly above 1 ($h(t) = 1.2792$, $p < .01$) showing that these investors have an increased probability of selling gains than other investors, relative to baseline. This analysis shows that those investors used in the questionnaire analysis are more prone to the disposition effect than investors not included because the probability of them holding gains is smaller.

Table 6:3 Comparison of the disposition effect for investors included in the questionnaire analysis and those investors not included

	Reg 1		Reg 2
TLI	.5782*** (-61.46)	TGI	1.6703*** (15.10)
TLI x questionnaire investor	.9922 (0.23)	TGI x questionnaire investor	1.2792*** (7.67)
Control variables			
Questionnaire investor	.8353*** (-9.24)	Questionnaire investor	.7335 (-13.02)
***, **, * - significant at 1,5 and 10% level			

6.2 The disposition effect with predictive variables

6.2.1 Sophistication

6.2.1.1 Complex financial products

In Chapter 2, it was argued that one of the best methods of measuring investor sophistication was to identify those investors who traded complex financial products. Hypothesis 2 predicted that these investors would be less susceptible to the disposition effect. The findings outlined in regression 4 of Table 6:4 and regression 4 of Table 6:5

present the hazard rates which test this hypothesis. The hazard rate for the interaction between the TLI and sophistication is significantly above 1 ($h(t) = 1.1304$, $p < .01$). This shows that the probability of sophisticated investors holding losses, relative to baseline, is less than other investors. The hazard rate for the interaction between the TGI and sophistication is significantly below 1 ($h(t) = .8519$, $p < .01$). This shows that the probability of sophisticated investors holding gains, relative to baseline, is greater than other investors. These findings support hypothesis 2, that sophisticated investors are less susceptible to the disposition effect. There are only a relatively small amount of investors who were classified as sophisticated. The significance of these findings is not that learning to trade complex financial products will reduce the disposition effect because most investors in this sample may never trade these products. Instead, sophistication can be used as indicator to show the extent to which technical knowledge can decrease the disposition effect. Thus, an estimate of the difference between sophisticated investors and other investors is of more relevance, than the result of sophistication by itself. The extent of this difference can be estimated by combining the hazard rates. The estimated hazard rate of the TLI for a sophisticated investor is .6502 ($.5752 \times 1.1304$) which is an increase of 12.47% from other investors. The estimated hazard rate for the TGI of a sophisticated investor is 1.4551 ($1.7081 \times .8519$) which is a decrease of 14.23% from the other investors.

This study finds that the influence of sophistication, measured by investors who trade complex financial products, decreases the disposition effect but it does not eliminate this bias. The same method of measuring sophistication was adopted by Seru et al. (2010) and Boolell-Gunesh et al., (2009). Both of these papers found similar results to that found in this thesis, which is that sophistication attenuated the disposition effect but did not eliminate it.

Overall, there is a weight of evidence that sophisticated investors are less susceptible to the disposition effect (Brown et al., 2006, Dhar and Zhu, 2006, Feng and Seasholes, 2005, Seru et al., 2010). This thesis contributes knowledge by showing that sophistication decreases the disposition effect for UK investors.

Table 6:4 Trading loss indictor with age, gender, stop loss user, sophistication and average trade value

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
TLI (Z-stat)	.4066*** (-38.74)	.5752*** (-59.64)	.5483*** (-53.01)	.5752*** (-62.57)	.6082*** (-50.81)
TLI x age (Z-stat)	1.1114*** (16.59)				
TLI x gender (Z-stat)		1.0290 (1.22)			
TLI x stop Loss user (Z-stat)			1.1331*** (7.44)		
TLI x sophistication (Z-stat)				1.1304*** (3.08)	
TLI x average trade value (Z- stat)					.99998*** (-10.81)
Control variables					
Age (Z-stat)	. 7597*** (-42.51)				
Age x log time (Z-stat)	1.0342*** (17.76)				
Gender (Z-stat)		.7954*** (-16.61)			
Stop loss (Z-stat)			1.2986*** (26.94)		
Sophistication (Z-stat)				.8357*** (-7.34)	
Average trade value (Z-stat)					1.0001*** (46.29)
***, **, * - significant at 1,5 and 10% level					

Table 6:5 Trading gain indicator with age, gender, stop loss user, sophistication and average trade value

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
TGI (Z-stat)	2.1268*** (36.36)	1.6886*** (59.77)	1.9233*** (61.48)	1.7081*** (64.36)	1.7142*** (59.20)
TGI x age (Z-stat)	.9334*** (-11.85)				
TGI x gender (Z-stat)		1.0384* (1.69)			
TGI x stop loss user (Z-stat)			.7461*** (-18.43)		
TGI x sophistication (Z-stat)				.8519*** (-4.14)	
TGI x average trade value (Z- stat)					1.0000 (-1.51)
Control variables					
Age (Z-stat)	.7866*** (-35.18)				
Age x log time (Z-stat)	1.0449*** (23.83)				
Gender (Z-stat)		.7887*** (-15.06)			
Stop loss user (Z-stat)			1.5585*** (40.40)		
Sophistication (Z-stat)				.9371*** (-2.50)	
Average trade value (Z-stat)					1.0000*** (36.13)
***, **, * - significant at 1,5 and 10% level					

In Chapter 2, I reviewed literature that used gender as a proxy for sophistication and argued that it is a poor proxy for sophistication in the UK. The literature review in chapter 2 outlined that gender had a significant influence in some research and was not significant in other research. I also include this variable in the analysis as a control variable. The purpose of this analysis is to identify the amount of influence that gender has on the disposition effect, in order to ascertain whether or not it should be controlled in this study.

The analysis shown in regression 2 of Table 6:4 and regression 2 of Table 6:5 investigate the influence of gender on the disposition effect. When gender is interacted with the TLI, the hazard rate is insignificant ($h(t) = 1.0290$, $p=0.224$) showing that a relationship between gender and the probability of holding losses, relative to baseline, cannot be detected in this data. When gender is interacted with the TGI, the hazard rate is significant at the 10% level (1.0384 , $p<.1$). This result is interesting as it suggests that the probability of holding gains, relative to baseline, is less for women than men. However, this result needs to be examined by the size of its influence, as well as its significance, because the sample size of this study is very large and this could cause small influences to be significant. The estimated TGI hazard rate for women is 1.7534 (1.6886×1.0384) which represents only a 3.35% increase from men. This is a very small difference between men and women in the amount of disposition effect exhibited. Overall, these results suggest that women do not differ from men in the probability of holding losses, relative to baseline, but have a slightly smaller probability of holding gains, relative to baseline, when the confidence level is relaxed to 90%.

This thesis finds a very small difference between men and women in the amount of disposition effect exhibited for this sample of UK investors. Therefore, gender is not a major concern and does not need to be controlled for in subsequent analysis using this data set. Feng and Seasholes (2005) found that men had less disposition effect than women. Their findings were robust with the probability of holding losses, relative to baseline, being 36% less for men and the probability of holding gains, relative to baseline, being 26% greater for men. Gender had an influence on the disposition effect for Taiwanese investors in one study (Shu et al., 2005) but had no influence in another (Barber et al., 2007). The inconsistent influence by gender on the disposition effect across countries suggests that the

gender effect may be related to differences in social gender roles rather than having a biological basis.

6.2.2 Experience

This thesis investigates the relationship between experience and the disposition effect using three proxies; age, years of experience and estimated cumulative trades. This section outlines the findings for each of these variables. However, it is important to note that there are different sample sizes for each variable. Age was measured in the trading data, so there is data from 4,328 investors who completed 65,096 roundtrip transactions for this analysis. The other two experience proxies were calculated using the investors' responses to the questionnaire. The data used for these variables comes from 261 investors who completed 4,193 roundtrip transactions. The results for each of these variables are outlined next.

6.2.2.1 Age

Two hypotheses were made in relation to the influence that age has on the disposition effect. Hypothesis 3 predicted that older investors would be less susceptible to the disposition effect and hypothesis 4 predicted that that older investors would be less susceptible to the disposition effect whilst average trade value was controlled for. In relation to the hypothesis 3, regression 1 in Table 6:4 and regression 1 in Table 6:5 show the analysis which tests this hypothesis. The hazard rate for the interaction between the TLI and age is significantly above 1 ($h(t) = 1.1114$, $p < .01$), showing that as age increases by 10 years, the probability of holding losses, relative to baseline, decreases by 11.14%. The estimate of the hazard rate of the TLI for a 28 year old investor is .4519 ($.4066 \times 1.1114^1$) and the estimate for a 68 year old investor is .6895 ($.4066 \times 1.1114^5$). The hazard rate for

the TGI interacted with age is significantly below 1 ($h(t) = .9334$, $p < .01$) showing that as age increases by 10 years, the probability of holding gains, relative to baseline, increases by 6.66%. The estimate of the hazard rate of the TGI for a 28 year old is 1.9852 ($2.1268 \times .9334^1$) and a 68 year old investor is 1.5068 ($2.1268 \times .9334^5$). These results support hypothesis 3, that older investors are less susceptible to the disposition effect than younger investors.

In Chapter 2, it was outlined that older investors tend to be wealthier than younger investors and that research has found that wealth decreases the disposition effect (Brown et al., 2006, Seru et al., 2010). For this reason the average trade value was measured for each investor to gauge whether the influence of age would decrease when average trade value is included in the analysis. A significant positive correlation was observed between age and average trade value ($r_s = .24$, $p < .01$). However, the results for the relationship between average trade value and the disposition effect were contrary to those found in other research. Regression 5 in Table 6:4 and Table 6:5 contain the analysis for average trade value with the TLI and TGI, respectively. The hazard rate for the interaction between average trade value and the TLI is significantly below 1 ($h(t) = .99998$, $p < .01$). This shows that as the average trade value increases, the probability of holding losses, relative to baseline, increases. The interaction between the TGI and average trade value is not significantly different to 1 ($h(t) = 1.0000$, $p = .13$) showing that the relationship between average trade value the probability of holding gains, relative to baseline, is not detected in this sample. The analysis was conducted with different permutations of average trade value, such as log transformations, and similar results were found. Overall, it was not

possible to conclude that investors with larger average trade values were less susceptible to the disposition effect.

Hypothesis 4 predicted that the older investors would exhibit less disposition effect than younger investors whilst controlling for average trade value. The analysis outlined in regression 1 and regression 2 of Table 6:6 test this hypothesis. The hazard rate for the interaction between age and the TLI is significantly above 1 ($h(t)= 1.1233$, $p<.01$) showing that the probability of holding losses, relative to baseline, decreases for older investors when average trade value is controlled for. The hazard rate for the interaction between the TGI and age is significantly below 1 ($h(t)= .9233$, $p< .01$) showing that the probability of holding gains, relative to baseline, increases for older investors when average trade value is controlled for. Overall, the results support hypothesis 4, that older investors are less likely to exhibit the disposition effect after average trade value is controlled for.

Table 6:6 Trading gain indicator and trading loss indicator with age and average trade value

	Reg 1		Reg 2
TLI	.4210*** (-36.70)	TGI	2.1606*** (36.63)
TLI x age	1.1176*** (17.40)	TGI x age	.9308*** (-12.33)
Control variables			
TLI x average trade value	.99998*** (-11.69)	TGI x log average trade value	1.0000 (-0.21)
Age	.7564*** (-43.10)	Age	.7851*** (-35.40)
Age x log time	1.0329*** (17.06)	Age x log time	1.0440*** (23.27)
Average trade value	1.0000*** (50.18)	Average trade value	1.0000*** (37.32)
***, **, * - significant at 1,5 and 10% level			

Research has investigated the influence that age has on the disposition effect. Dhar and Shu (2006) found that an increase in age decreased the disposition effect. Other research investigating the relationship between age and the disposition effect studied Chinese investors (Chen et al., 2007, Feng and Seasholes, 2005). As mentioned earlier, this research uses age as a variable for sophistication because it is relative to economic reforms in China. This makes it difficult to compare the results of this thesis to their research. Nonetheless, the results from this thesis contribute to knowledge as they extend findings which show that older investors have decreased disposition effect. Looking more broadly at the relationship between ageing and investment performance, recent research has argued that older investors will have better investment choices due to experience but will have worse investment skill due to a decline in cognitive ability (Korniotis and Kumar, 2011). Korniotis and Kumar (2011) found that older investors show less susceptibility to behavioural biases yet exhibit poorer skills at stock selection. Findings from this thesis indicate that older investors exhibit less disposition effect, endorsing the first aspect of Korniotis and Kumar's (2011) findings.

6.2.2.2 *Years of experience*

Hypothesis 5 predicted that as years of experience increased, the disposition effect would decrease. The analysis in Table 6:7 regression 1 and regression 4 show the hazard rates for the years of experience with the TLI and TGI, respectively. The hazard rate for the interaction between the TLI and experience in years is not significant ($h(t) = 1.0034$, $p = .193$) and the hazard rate for the interaction between the TGI and years of experience is not significant ($h(t) = 1.0012$, $p = 0.626$). These results show that a relationship between

investment experience the disposition effect cannot be observed in this data. However, a log transformation of years of experience was conducted and the analysis using this is outlined in regression 2 and regression 5 of Table 6:7. The interaction between the TLI and log years of experience is significantly above 1 ($h(t) = 1.1269$, $p < .01$) showing that as log years of experience increases, the probability of holding losses, relative to baseline, decreases. The interaction between the TGI and log years of experience is significantly below 1 ($h(t) = .9227$ $p < .01$) showing that as log years of investment experience increases, the probability of holding gains, relative to baseline, increases. Overall, there is evidence to support hypothesis 5. The finding that only the log transformation of years of experience has a detectable influence at decreasing the disposition effect suggests that early experience is more relevant to alleviating the disposition effect than later experience. In other words, the difference between 1 to 2 years of investment experience has more influence than the difference between 11 to 12 years of investment experience.

Before any solid conclusions are drawn about the relationship between years of experience and the disposition effect, it is necessary to ascertain whether experience would still reduce the disposition effect when age is included. Chapter 5 outlined that an investor's age is correlated with log years of experience ($r = .47$, $p < .01$). The results outlined in regression 3 and 6 of Table 6:7 show the influence of log investment experience when age is considered. The hazard rate for the interaction between the TLI and log investment experience in years is insignificant ($h(t) = 1.0292$, $p = 0.449$), yet the hazard rate for interaction between the TLI and age is significantly above 1 ($h(t) = 1.1284$, $p < .01$). This shows that when age is also considered, a significant relationship between log years of experience and the probability of holding losses, relative to baseline, cannot be detected. In relation to the probability of

holding gains, the interaction between the TGI and log years of experience is significantly below 1 at the 10% level ($h(t) = .9423$, $p = .091$) and the interaction between the TGI and age is significantly below 1 at the 10% level ($h(t) = .9472$, $p = .060$). This shows that the significance of both experience and age decrease when included together in the TGI analysis. Overall, the results show that age is a better predictor of susceptibility to the disposition effect than log years of experience.

There are many possible reasons why age is better than experience in years at explaining individual differences in the disposition effect. Firstly, it could be due to age being more accurately measured than years of experience because the former variable was measured in the trading data and the latter was measured via self reported data. It could also imply that age encapsulates more relevant experience than years of experience. It is highly likely that investors learn from experiences outside of investment that shape how they make their investment decisions. Finally, as the experience variables are measured using the questionnaire the sample size ($N=261$) may not be large enough to tease out significant differences between age and investment experience in years. Overall, there is support for hypothesis 5, that experience measured in years decreases the disposition effect but it would appear that age is a better measure of this variable.

Table 6:7 Trading gain indicator and trading loss indicator with years of experience, log years of experience and age

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6
TLI (Z-stat)	.4883*** (-13.74)	.3955*** (-11.53)	.3074*** (-11.04)			
TLI x years of experience (Z-stat)	1.0034 (1.30)					
TLI x log years of experience (Z-stat)		1.1269*** (3.73)	1.0292 (0.76)			
TLI x age (Z-stat)			1.1284*** (3.85)			
TGI (Z-stat)				1.9805*** (14.08)	2.3933*** (12.20)	2.8071*** (10.91)
TGI x years of experience (Z-stat)				1.0012 (0.49)		
TGI x log years of experience (Z-stat)					.9227*** (-2.77)	.9423* (-1.69)
TGI x age (Z-stat)						.9472* (-1.88)
Control variables						
TLI						
Years of experience	.9973* (-1.80)			.9977*** (-1.29)		
Log years of experience (Z-stat)		.8918*** (-6.79)	.9034*** (-4.85)		.9655 (-1.57)	.9391*** (-2.34)
Age (Z-stat)			.8533*** (-4.84)			.8796*** (-3.57)
Age x log time (Z-stat)			1.0449*** (5.18)			1.0572*** (6.64)
***, **, * - significant at 1,5 and 10% level						

The result that age is a better predictor than years of experience is contrary to other research which has found that experience in years was relevant to decreasing the disposition effect. Chen et al. (2007) found that years of experience decreased the disposition effect. Seru et al. (2010) found that years of experience slightly decreased the disposition effect but experience in cumulative trades was more relevant. Neither of these

two studies reported using a log transform of years of experience. A contribution of this thesis is that this transformation improves the findings for the influence that experience has on the disposition effect. Furthermore, a finding of this thesis is that age explains more susceptibility to the disposition effect than years of investment experience. Research on the disposition effect has never incorporated age and a log transform of years of experience into the same analysis before.

6.2.2.3 *Estimated cumulative trades*

Another measure of investment experience can be gauged by the cumulative amount of trades that an investor has completed. Hypothesis 6 predicted that investors with more cumulative trades would exhibit less disposition effect. It was outlined in Chapter 4 that this variable could not be directly measured in this data but was estimated. The results of the analysis for estimated cumulative trades are outlined in Table 6:8 regression 1 and regression 4. The hazard rate for the interaction between the TLI and estimated cumulative trades is insignificant ($h(t)=1.000$, $p=.296$) and the hazard rate for the interaction between the TGI and estimated cumulative trades is insignificant ($h(t) = 1.000$, $p=.121$). Like experience in years, the estimated cumulative trades variable was also converted using a log transformation and the results are presented in regression 2 and 5. The hazard rate for the interaction between the TLI and log estimated cumulative trades is significantly above 1 ($h(t)=1.0849$, $p<.01$) indicating that higher log estimated cumulative trades, decreases the probability of holding losses, relative to baseline. The interaction between the TGI and log estimated cumulative trades is significantly below 1 ($h(t)=.9233$, $p<.01$) showing that high estimated cumulative trades, increases the probability of holding gains, relative to baseline.

As outlined in Chapter 5, there is a high correlation between log estimated cumulative trades and age ($r = .40$, $p < .01$). So analysis was conducted that also included age and the results are presented in regression 3 and regression 6 of Table 6:8. When age is included in the analysis, the hazard rate for the interaction between the TLI and log estimated cumulative trades is insignificant ($h(t) = 1.0052$, $p = .839$) whilst the hazard rate for the interaction between the TLI and age remains significantly above 1 ($h(t) = 1.1450$ $p < .01$). This implies that age is more relevant than log estimated cumulative trades in determining the probability of holding losses, relative to baseline. The hazard rate for the interaction between the TGI and log estimated cumulative trades is significantly below 1 ($h(t) = .9362$, $p < .01$) whilst the hazard rate for the interaction between the TGI and age is insignificant ($h(t) = .9552$, $p = 0.106$). This implies that log estimated cumulative trades are more relevant than age when determining the probability of holding gains, relative to baseline. Overall, the results show support for hypothesis 6 because an increase in log estimated cumulative trades is associated with a decrease in the disposition effect. However, when age is included in the analysis the results become puzzling. The results show that log estimated cumulative trades predicts an increase probability of holding gains but age does not, in this sample. However, log estimated cumulative trades does not predict a decrease in the probability of holding losses but age does, in this sample.

Table 6:8 Trading gain indicator and trading loss indicator with estimated cumulative trades, log estimated cumulative trades and age

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6
TLI (Z-stat)	.5120*** (-16.92)	.3076*** (-8.68)	.2934*** (-8.71)			
TLI x estimated cumulative trades (Z-stat)	1.000 (-1.05)					
TLI x log estimated cumulative trades (Z-stat)		1.0849*** (3.78)	1.0052 (0.20)			
TLI x age (Z-stat)			1.1450*** (4.39)			
TGI (Z-stat)				2.0082*** (18.82)	3.3134*** (-9.65)	3.6275*** (10.13)
TGI x estimated cumulative trades (Z-stat)				1.0000 (1.55)		
TGI x log estimated cumulative trades (Z-stat)					.9233*** (-4.00)	.9362*** (-2.75)
TGI x age (Z-stat)						.9552 (-1.61)
Control variables						
Estimated cumulative trades (Z-stat)	1.0001*** (12.69)			1.0001*** (9.30)		
Log estimated cumulative trades (Z-stat)		1.0613*** (5.02)	1.1476*** (9.45)		1.1384*** (8.68)	1.1928*** (9.85)
Age (Z-stat)			.7115*** (-10.37)			.7281*** (-8.85)
Age x log time (Z-stat)			1.0587*** (6.74)			1.0729*** (8.41)
***, **, * - significant at 1,5 and 10% level						

As mentioned earlier, Seru et al. (2010) found that cumulative trading frequency is more influential at reducing the disposition effect than years of investment experience. They control for investor attrition which increases the accuracy of their analysis because poor performing investors may often cease trading (Seru et al., 2010). However, their research focused solely on the probability of holding gains, aspect of the disposition effect. A

contribution to knowledge of this thesis is that it shows a potential problem with this approach. This research shows that experience measured by the number of cumulative trades influences the probability of holding gains but not the probability of holding losses, when age is considered. Therefore, future research needs to consider both the gains and losses aspects of the disposition effect. Feng and Seasholes (2005) also researched the influence that cumulative trades had on the disposition effect and their result is the differs to that found in this thesis. They found that an increase in cumulative trades significantly decreased the probability of holding losses but did not significantly change the probability of holding gains. A possible reason why a difference exists in Feng and Seasholes' (2005) findings compared to this thesis, is that their data is for investors who are new to trading and follows them over a 2-year period. It may be that learning effects of experience mostly occur early (this would be consistent with data in the present study). As already stated this research estimated the cumulative trading frequency based on years of investment experience and current trading volume. This makes the measure less accurate but means that the measure covers a longer period of trading.

6.2.3 Stop loss strategies

In Chapter 2 it was hypothesised that stop losses strategies are an effective method of inoculating against the disposition effect. Subsequently, Chapter 4 outlined two variables for stop losses, a stop loss user variable and a stop loss transaction variable. The results for the stop loss user variable are outlined in regression 3 of Table 6:4 and regression 3 of Table 6:5. The interaction between the TLI and stop loss user is significantly above 1 ($h(t) = 1.1331$, $p < .01$) showing that being a stop loss user decreases the probability of holding losses by 13.31%, relative to baseline. The estimate of the hazard rate of the TLI for a stop loss user is

.6212 (.5483x 1.1331) showing that stop loss users are still reluctant to realise losses. The interaction between the TGI and stop loss user is significantly below 1 ($h(t) = .7461$, $p < .01$) showing that being a stop loss user increases the probability of holding gains by 25.39%, relative to baseline. The estimate of the hazard rate of the TGI for a stop loss user is 1.4350 ($1.9233 \times .7461$). The influence of stop loss strategies is quite profound because it has more influence in reducing the disposition effect than sophistication in this data. These results confirm hypothesis 7, which posited that investors who use stop losses will exhibit the disposition effect to a lesser extent.

The results for the stop loss transaction variable are outlined in regression 1 and 2 of Table 6:9. The hazard rate for the interaction between the TLI and the stop loss transaction variable is significantly above 1 ($h(t) = 2.1527$, $p < .01$). The estimated hazard ratio for the TLI in a stop loss transaction is 1.1566 ($.5373 \times 2.1527$). The hazard rate for the interaction between the TGI and the stop loss transaction variable is significantly below 1 ($h(t) = .5225$, $p < .01$). The estimated hazard ratio for the TGI in a stop loss transaction is .9394 ($1.7978 \times .5225$). These results show that for transactions which involve stop losses, the disposition effect is not only inoculated against but is reversed, with the probability of holding gains being greater than the probability of holding losses.

Table 6:9 Trading gain indicator, trading loss indicator with stop loss transactions

	Reg 1	Reg 2
TLI (Z-stat)	.5373*** (-68.02)	
TLI x stop loss transaction (Z-stat)	2.1527*** (27.93)	
TGI (Z-stat)		1.7978*** (69.15)
TGI x stop loss transaction (Z-stat)		.5225*** (-23.48)
Control variables		
Stop loss transaction (Z-stat)	.8140*** (-11.63)	
Stop loss transaction (Z-stat)		1.4375*** (20.75)
***, **, * - significant at 1,5 and 10% level		

Literature which investigates stop losses has focused on whether stop loss strategies are an optimal means of investing (Dybvig, 1988, Lei and Li, 2009). Lei and Li (2009) retrospectively applied automatic stop loss strategies to investments and found that these strategies do not hurt investment performance. However, they did not consider the extent to which stop losses inoculate an investor from the disposition effect, given their attitude to risk. A contribution to knowledge by this thesis is that it finds that stop losses are an effective tool at curbing this bias. Investors who use stop losses suffer less from the disposition effect and the transactions which include stop losses show reverse disposition effect.

6.3 Combined variance analysis

The final section of the chapter presents the combined analysis of all the variables which had a significant influence at decreasing the disposition effect. The purpose of doing this is to estimate how much variation in the disposition effect can be explained by the

demographic variables. The first analysis is for the sample of investors from the trading data and it combines sophistication, age and stop loss user. The second analysis is for the investors in the questionnaire data and it combines sophistication, age, stop loss user and log estimated cumulative trades.

6.3.1 Combined variance analysis for variables measured in the trading data

The variables measured in the trading data which had a significant influence on the disposition effect are sophistication, age and stop loss user. Table 6:10 contains the combined analysis for these variables with regression 1 and regression 2 showing the findings for the TLI and TGI, respectively. One change which has occurred from the previous analysis is that the hazard rate for the interaction between the TLI and sophistication is not significant ($h(t)=1.0601$, $p=.142$). This may be due to the small number of investors in the sample who were classified as sophisticated ($N=79$). Nonetheless, I have included the influence of sophistication in the estimate of variance explained by these variables because it has a significant influence with the TGI and I desire an equal comparison between the TLI and TGI. The hazard rate for the TLI of a 68 year old investor who uses stop losses and trades complex financial products is 0.8005 ($.3749 \times 1.0601 \times 1.1162^5 \times 1.1626$). This represents a 38.60% increase from the aggregate TLI hazard rate of .5781. The hazard rate for the TGI of a 68 year old investor who uses stop losses and trades complex financial products is 1.1168 ($2.4928 \times .8855 \times .9263^5 \times .7419$). This represents a 34.17% decrease from the aggregate investor TGI hazard rate of 1.6966.

Table 6:10 Trading gain indicator and trading loss indicator with sophistication, age and stop loss user for the trading data sample

	Reg 1		Reg 2
TLI (Z-stat)	.3749*** (-39.42)	TGI (Z-stat)	2.4928**** (40.83)
TLI x sophistication (Z-stat)	1.0601 (1.47)	TGI x sophistication (Z-stat)	.8855*** (-3.13)
TLI x age (Z-stat)	1.1162*** (17.19)	TGI x age (Z-stat)	.9263*** (-13.11)
TLI x stop loss user (Z-stat)	1.1626*** (8.93)	TGI x stop loss user (Z-stat)	.7419*** (-18.72)
Control variables			
Sophistication (Z-stat)	.8790*** (-5.27)	Sophistication (Z-stat)	.9466** (-2.11)
Age (Z-stat)	.7657*** (-41.11)	Age (Z-stat)	.7970*** (-33.10)
Age x log time (Z-stat)	1.0333*** (17.30)	Age x log time (Z-stat)	1.0442*** (23.36)
Stop loss user (Z-stat)	1.2617*** (23.90)	Stop loss user (Z-stat)	1.5315*** (38.65)
***, **, * - significant at 1,5 and 10% level			

6.3.2 Combined variance analysis for the questionnaire data

A combined variable analysis was also completed for the investors who are included in the questionnaire analysis. The purpose of this is to obtain an estimate of the variance explained in this data by sophistication, experience and stop loss user. Later this information will be compared to the variance explained by the psychological variables to ascertain whether or not the psychological variables explain extra variance in the disposition effect. The results are outlined in Table 6:11 with regression 1 pertaining to the TLI and regression 2 pertaining to the TGI. When the variables were combined in an analysis some of them became insignificant. Firstly, the hazard rate for the interaction between the TLI and sophistication is insignificant ($h(t)= 1.3692$, $p = .283$) and the hazard rate for the

interaction between the TGI and sophistication is insignificant ($h(t) = .6453$, $p = .128$). This is probably due to the small numbers of sophisticated investors in the respondents to the questionnaire ($N=7$). Secondly, the hazard rate for the interaction between the TGI and log estimated cumulative trades is insignificant ($h(t) = .9824$, $p = 0.474$). This implies that when age and stop loss use are considered, experience, measured by log estimated cumulative trades, is no longer a predictor of susceptibility to the disposition effect for this sample. This could occur because age and stop loss use encapsulates the susceptibility to the disposition effect measured by log estimated cumulative trades or it could occur because the sample size ($N=261$ investors) is too small to show significant results for all of these variables.

Table 6:11 Trading gain indicator and trading loss indicator with sophistication, age, stop loss user and log estimated cumulative trades for the questionnaire sample

	Reg 1		Reg 2
TLI (Z-stat)	.2761*** (-9.09)	TGI (Z-stat)	3.9278*** (10.71)
TLI x sophistication (Z-stat)	1.3692 (1.07)	TGI x sophistication (Z-stat)	.6454 (-1.52)
TLI x age (Z-stat)	1.1488*** (4.42)	TGI x age (Z-stat)	.9454* (-1.94)
TLI x stop loss user (Z-stat)	1.6216*** (7.03)	TGI x stop loss user (Z-stat)	.5350*** (-9.58)
TLI x log estimated cumulative trades (Z-stat)	.9707 (-1.13)	TGI x log estimated cumulative trades (Z-stat)	.9824 (-.072)
Control variables			
Sophistication (Z-stat)	.6257** (-2.50)	Sophistication (Z-stat)	.8652 (-0.71)
Age (Z-stat)	.7147*** (-10.19)	Age (Z-stat)	.7349*** (-8.45)
Age x log time (Z-stat)	1.0577*** (6.63)	Age x log time (Z-stat)	1.0716*** (8.19)
Stop loss user (Z-stat)	1.0599*** (1.48)	Stop loss user (Z-stat)	1.7507*** (11.51)
Log estimated cumulative trades (Z-stat)	1.1416*** (8.80)	Log estimated cumulative trades (Z-stat)	1.1453*** (7.33)
***, **, * - significant at 1,5 and 10% level			

As insignificant results were found for sophistication and log estimated cumulative trades, these variables were dropped and the analysis ran using age and stop loss user. The reason for excluding these variables is that, if these insignificant items were included in analysis, they would change the amount of variance explained by the age and stop loss user variables. The results, with sophistication and log estimated trades omitted, are outlined in Table 6:12 with regression 1 pertaining to the TLI and regression 2 pertaining to the TGI. The hazard rates can be combined to give an estimate for the amount of variance explained by the variables in the questionnaire data. The estimated hazard rate for the TLI of a 68 year old investor who uses stop losses is $.7317(.2564 \times 1.1290^5 \times 1.5557)$. The estimated hazard rate for the TGI of a 68 year old investor is $1.3859(3.6050 \times .9317^5 \times .5476)$. Overall, these estimates show that the age and stop loss user variables explain some variation in the disposition effect but not all of it.

Table 6:12 Trading gain indicator and trading loss indicator with age and stop loss user for the questionnaire sample

	Reg 1		Reg 2
TLI (Z-stat)	.2564*** (-12.42)	TGI (Z-stat)	3.6050*** (13.08)
TLI x age (Z-stat)	1.1290 *** (4.62)	TGI x age (Z-stat)	.9317*** (-2.97)
TLI x stop loss user (Z-stat)	1.5557*** (6.61)	TGI x stop loss user (Z-stat)	.5476*** (-9.53)
Control variables			
Age (Z-stat)	.7989** (-7.29)	Age (Z-stat)	.8293*** (-5.64)
Age x log time (Z-stat)	1.0500*** (5.78)	Age x log time (Z-stat)	1.0622*** (7.19)
Stop loss user (Z-stat)	1.1680*** (4.10)	Stop loss user (Z-stat)	1.8813*** (13.28)
***, **, * - significant at 1,5 and 10% level			

6.4 Conclusion

This chapter presented the findings for the demographic variables used in this thesis. It showed that the disposition effect occurred in the UK and that sophistication and age reduced susceptibility to this bias. It also explored the relationship between the other two measures of experience and the disposition effect. It found that log transformations of these variable produced significant results. When age was included in the analysis, the influence of log years of experience was not significant. Likewise, when age was included in the analysis, the influence of log estimated cumulative trades was not significant on the probability of holding losses. However, when age was included, the influence of log estimated cumulative trades was significant on the probability of holding gains. The chapter also highlighted the influence of stop loss strategies. It showed that stop loss users had less disposition effect than sophisticated investors. When analysed at the transaction level, stop losses reversed the disposition effect. Finally, the chapter looked at the amount of variation in the disposition effect explained by the demographic variables. It was shown that these variables explained significant variation in the disposition effect, but by no means all of it.

Chapter 7. Findings for the psychological variables

The previous chapter outlined the findings on susceptibility to the disposition effect for the various demographic variables. It showed that both sophisticated and experienced investors were less susceptible to this bias. Also stop loss strategies are useful at inoculating against the disposition effect. The purpose of this chapter is to present the findings for susceptibility to the disposition effect for the psychological variables and discuss how they contribute knowledge to the relevant literature. The first section presents the findings for dual process theory by showing whether individual differences in reliance on system 1 and system 2 cognition are related to the disposition effect. The second section outlines the findings for emotion regulation. It shows whether individual differences in reappraisal and expressive suppression are related to how long investors hold gains and losses. The third section combines estimates the amount of variance in the disposition effect that can be explained by these psychological variables.

7.1 Findings for dual process theory and the disposition effect

In Chapter 3, it was hypothesised that individual differences in reliance on system 1 and system 2 cognition would predict differences in the disposition effect. Subsequently, in Chapter 5 it outlined that the REI (Norris and Epstein, 2009) would be used to measure individual differences in system 1 and system 2 cognition, with the experiential scale measuring system 1 cognition and the rational scale measuring system 2 cognition. This section outlines the findings of dual process theory and the disposition effect. It begins by showing the findings for the experiential and rational scale and then presents the findings

for the subscales. The final analysis includes control variables, to identify whether dual process theory has an influence on the disposition effect when age, stop loss use and sophistication are considered. Following the presentation of the findings, a discussion about the relevance of results is outlined. The first discussion is about why some subscales of the REI present significant results and others do not. The second discussion relates the findings back to literature on the disposition effect and dual process theory in decision making, to show the significant contributions made to knowledge.

7.1.1 Rational and Experiential scales

Hypothesis 8 predicted that investors with higher reliance on system 1 cognition would be more susceptible to the disposition effect. The results presented in Table 7:1 and Table 7:2 contain the findings for relationship between the experiential scale and the disposition effect. Regression 2 in Table 7:1 shows the influence that the experiential scale has the probability of holding losses. The hazard rate for the interaction between the TLI and the experiential scale is significantly below 1 ($h(t) = .8556$, $p < .01$) indicating that the probability of holding a loss, relative to baseline, increases for those investors who score highly on this scale. The results in regression 2 of Table 7:2 show the influence that the experiential scale has on the probability of holding gains. The hazard rate for the interaction between the TGI and the experiential scale is significantly above 1 ($h(t) = 1.1394$, $p < .01$), indicating that the probability of holding a gain, relative to baseline, decreases for those investors who score highly on this scale. Overall, these results show support for hypothesis 8, that higher reliance on system 1 cognition is associated with greater disposition effect.

Hypothesis 9 predicted that investors higher in system 2 processes would be less susceptible to the disposition effect. The findings for the influence that the rational scale has on the probability of holding losses and gains are outlined in regression 1 of Table 7:1 and regression 1 of Table 7:2, respectively. The hazard rate for the interaction between the rational scale and the TLI is insignificant ($h(t)= 1.1010$, $p=.127$) and the hazard rate for the interaction between the TGI and the rational scale is insignificant ($h(t)= 1.0275$, $p= 0.64$). This indicates that no significant influence can be found in this data for the relationship between the rational scale and the disposition effect. It does not show support for hypothesis 9.

Table 7:1 Trading loss indicator with the rational and experiential scales

	Reg 1	Reg 2	Reg 3
TLI (Z-stat)	.3518*** (-4.17)	.8432 (-.88)	.6601 (-1.14)
TLI x rational (Z-stat)	1.1010 (1.52)		1.0589 (0.88)
TLI x experiential (Z-stat)		.8556*** (-2.59)	.8611** (-2.39)
Control variables			
Rational (Z-stat)	.9072*** (-2.86)		.9160** (-2.54)
Experiential (Z-stat)		1.0695** (2.00)	1.0537 (1.52)
***, **, * - significant at 1,5 and 10% level			

Table 7:2 Trading gain indicator with the rational and experiential scales

	Reg 1	Reg 2	Reg 3
TGI (Z-stat)	1.8140*** (2.60)	1.3281 (1.55)	.9655 (-.11)
TGI x rational (Z-stat)	1.0275 (0.47)		1.0646 (1.05)
TGI x experiential (Z-stat)		1.1394** (2.32)	1.1661*** (2.63)
Control variables			
Rational (Z-stat)	.9140*** (-2.05)		.8914 ** (-2.52)
Experiential (Z-stat)		.9427 (-1.39)	.9140** (-2.02)
***, **, * - significant at 1,5 and 10% level			

7.1.2 Rational and Experiential Subscales

The next set of analysis investigates the influence that the rational and experiential subscales have on the disposition effect. There are two subscales for each scale in the REI and these are referred to as ability and preference. A definition of each of these subscales is offered by Pacini and Epstein who state (1999, p. 974) rational ability “refers to reports of a high level of ability to think logically and analytically” and rational preference “refers to reliance on and enjoyment of thinking in an analytical, logical manner”, intuitive ability “refers to reports of a high level of ability with respect to one's intuitive impressions and feelings” and intuitive preference “refers to reliance on and enjoyment of feelings and intuitions in making decisions”. Table 7:3 and Table 7:4 show the results for the REI subscales with the TLI and TGI, respectively. Regression 1 and regression 2 in Table 7:3 show the findings for the influence that the rational preference and rational ability subscale have on the probability of holding losses, respectively. The hazard rate for the interaction

between the TLI and the rational preference subscale is significantly above 1 ($h(t) = 1.1982$, $p < .01$), but the hazard rate for the interaction between the TLI and the rational ability subscale is insignificant ($h(t) = .9589$, $p = 0.488$). These findings suggest that the probability of holding losses, relative to baseline, decreases for those investors who score highly on the rational preference subscale. Yet, there is no significant relationship detectable in this data between the rational ability subscale and the probability of holding losses.

Regression 1 and regression 2 in Table 7:4 show the influence of the rational preference and rational ability subscales on the probability of holding gains, respectively. The hazard rate for the interaction between the TGI and the rational preference subscale is significantly below 1 ($h(t) = .8939$, $p < .05$) and the hazard rate for the interaction between the TGI and the rational ability scale is significantly above 1 ($h(t) = 1.2002$, $p < .01$). These results indicate that the probability of holding gains, relative to baseline, increases for those investors with high scores on the rational preference subscale. Whereas, the probability of holding gains, relative to baseline, decreases for those investors with high scores on the rational ability subscale. Overall, these results suggest that high scores on the rational preference subscale decrease the disposition effect but high scores on the rational ability subscale increase it. This could explain why insignificant results were found for the rational scale in Table 7:1 and Table 7:2. That is, each of the rational subscales has an antagonistic relationship on the disposition effect, causing the rational scale to have no influence.

In relation to the experiential subscales, regression 3 and regression 4 in Table 7:3 show the relationships between the TLI and the experiential preference subscale and the TLI and experiential ability subscale, respectively. The hazard rate for the interaction between the

TLI and experiential preference subscale is insignificant ($h(t) = .9263$, $p = .142$) and the hazard rate for the interaction between the TLI and experiential ability subscale is significantly below 1 ($h(t) = .8217$, $p < .01$). The results show that the probability of holding losses, relative to baseline, decreases for investors with higher scores on the experiential ability. There is no significant relationship detected in this data between the experiential preference subscale and probability of holding losses, relative to baseline.

The influence of the experiential subscales on the probability of holding gains is outlined in regression 3 and 4 in Table 7:4. The hazard rate for the interaction between the TGI and the experiential preference subscale is insignificant ($h(t) = 1.0031$, $p = .95$). The hazard rate for the interaction between the TGI and the experiential ability subscale is significantly above 1 ($h(t) = 1.2763$, $p < .01$), indicating that the probability of holding gains, relative to baseline, decreases for those investors with higher scores on the experiential ability subscale. These results show that a significant relationship exists between the experiential ability subscale and the probability of holding gains, relative to baseline. However, no significant relationship was detected in this data between the experiential preference subscale and the probability of holding gains, relative to baseline. Overall, the results indicate that experiential ability is significant at increasing the disposition effect but no significant relationship was observed between experiential preference and the disposition effect.

Table 7:3 Trading loss indicator with the rational and experiential subscales

	Reg 1	Reg 2	Reg 3	Reg 4
TLI (Z-stat)	.2582*** (-6.36)	.6090** (-2.00)	.6543** (-2.54)	.9637 (-.19)
TLI x rational preference (Z-stat)	1.1982*** (3.28)			
TLI x rational ability (Z-stat)		.9589 (-0.69)		
TLI x experiential preference (Z-stat)			.9263 (-1.47)	
TLI x experiential ability (Z-stat)				.8217*** (-3.36)
Control variables				
Rational preference (Z-stat)	.9519 (-1.64)			
Rational ability (Z-stat)		.8855*** (-3.69)		
Experiential preference (Z-stat)			1.0823*** (2.73)	
Experiential ability (Z-stat)				1.0248 (0.75)
***, **, * - significant at 1,5 and 10% level				

Table 7:4 Trading gain indicator with the rational and experiential subscales

	Reg 1	Reg 2	Reg 3	Reg 4
TGI (Z-stat)	3.0824*** (5.77)	.9618 (-.17)	1.9926*** (4.38)	.9174 (-.48)
TGI x rational preference (Z-stat)	.8939** (-2.20)			
TGI x rational ability (Z-stat)		1.2002*** (3.28)		
TGI x experiential preference (Z-stat)			1.0031 (0.06)	
TGI x experiential ability (Z-stat)				1.2763*** (4.46)
Control variables				
Rational preference (Z-stat)	1.0657* (1.65)			
Rational ability (Z-stat)		.7861*** (-5.76)		
Experiential preference (Z-stat)			1.0523 (1.38)	
Experiential ability (Z-stat)				.8369*** (-4.32)
***, **, * - significant at 1,5 and 10% level				

7.1.3 Rational and experiential scales and subscales with control variables

The final step in the analysis is to determine if the rational and experiential scales and subscales can explain susceptibility to the disposition effect when control variables are included. For sake of brevity, only the results for the REI scales and subscales which had a significant influence are shown. These are the experiential and rational scales and the experiential ability, rational preference and rational ability subscales. The control variables included in this analysis are those which were found to have a significant influence for this dataset. These variables are age, stop loss use and sophistication. As mentioned in Chapter 5, it is difficult to include sophistication as a control variable because only a few investors

(N=7) who were deemed sophisticated, responded to the questionnaire. Thus, a self-rated expertise variable was created to control for the influence that sophistication would have on the disposition effect. Also, other control variables such as log estimated cumulative trades, sophistication (measured by those who traded complex products) and gender, and combinations thereof were trialled. The use of these control variables did not significantly differ the findings from those presented here (the analysis is omitted for brevity sake but can be viewed in appendix 8). The influence that the experiential scale, experiential ability subscale, the rational scale, the rational preference subscale and rational ability subscale have the probability of holding gains and losses relative to baseline, when control variables are included, is outlined in Table 7:5 and Table 7:6, respectively.

7.1.3.1 *Experiential and experiential ability subscales*

Regression 1 in Table 7:5 shows that the hazard rate for the interaction between the TLI and the experiential scale is not significant ($h(t) = .9625$, $p = .57$). This indicates that when other variables are considered, individual differences in system 1 cognition do not influence the probability of holding losses, relative to baseline. Regression 1 in Table 7:6 shows that the hazard rate for the interaction between the TGI and the experiential scale is significantly above 1 ($h(t) = 1.1367$, $p < .05$) when control variables are included. This result shows that when other variables are considered, the probability of holding gains, relative to baseline, decreases for those investors who report higher reliance on system 1 processing. Similar findings are found for the experiential ability subscale which is reported in regression 2 of Table 7:5 and Table 7:6. The hazard rate for the interaction between the TLI and experiential ability is insignificant ($h(t) = .9412$ $p = .333$) but the hazard rate for the

interaction between the TGI and experiential ability is significantly above 1 ($h(t) = 1.2161$, $p < .01$).

When control variables were included the influence of the experiential scale and experiential ability on the probability of holding losses became insignificant. This may be due to the inclusion of age in the analysis because it has a negative correlation with the experiential scale ($r = -.2794$, $p < .01$) and the experiential ability scale ($r = -.2952$, $p < .01$). Furthermore, in relation to the probability of holding gains, when the experiential scale and the experiential ability scale were included in the analysis, age became insignificant. This also suggests that the negative correlation between age and these scales is influencing the results. Overall, the results for both the experiential scale and experiential ability subscale support hypothesis 8 and show that investors who report a higher reliance on system 1 cognitive processes are more susceptible to the selling gains aspect of the disposition effect.

7.1.3.2 Rational scale, rational ability and rational preference subscales

The relationships between the rational preference scale and the probability of holding losses and gains are outlined in regression 3 of Table 7:5 and Table 7:6, respectively. The hazard rate for the interaction between the TLI and the rational preference subscale is significantly above 1 ($h(t) = 1.2500$, $p < .01$) and the hazard rate for the interaction between the TGI and rational preference subscale is significantly below 1 ($h(t) = .8603$, $p < .01$). These results show that the rational preference subscale significantly reduces the disposition effect in addition to the control variables.

The findings for the influence that the rational ability subscale has on the probability of holding gains and losses are outlined in regression 4 of Table 7:5 and Table 7:6, respectively. The hazard rate for the interaction between the TLI and the rational ability subscale is not significant ($h(t) = 1.0237$ $p = 0.70$), indicating that a significant relationship between the probability of holding losses and the rational ability scale cannot be detected, when control variables are included in the regression. The hazard rate for the interaction between the TGI and the rational ability subscale is above 1 ($h(t) = 1.1072$, $p = 0.071$) but only significant at the 10% level. This result indicates that the probability of holding gains, relative to baseline, decreases for those investors who scored highly on the rational ability scale. However, the significance of this result has dropped to the 10% level of significance when control variables are included.

Finally, the results for the influence that the rational scale has on the probability of holding losses and gains are outlined in regression 5 of Table 7:5 and Table 7:6, respectively. The hazard rate for the interaction between the TLI and the rational scale is significantly above 1 ($h(t) = 1.1646$ $p < .05$). This indicates that the probability of holding losses relative to baseline decreases for those investors with higher scores on the rational scale when control variables are included. The hazard rate for the interaction between the TGI and the rational scale is not significant ($h(t) = .9660$, $p = .566$). This indicates that a relationship cannot be detected between the rational scale and the probability of holding gains, relative to baseline, when control variables are included. Overall, the results of the rational scale and subscales when control variables are included show tentative support for hypothesis 9. Investors who report higher reliance on system 2 cognition show a higher probability of selling losses and, are therefore, less susceptible to the disposition effect.

Table 7:5 Trading loss indicator with the REI scales and subscales when control variables are considered

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Questionnaire variable	Experiential	Experiential ability	Rational preference	Rational ability	Rational
TLI (Z-stat)	.3487*** (-3.28)	.3796*** (-3.27)	.1498*** (-7.87)	.2653*** (-4.71)	.1746*** (-6.33)
TLI x questionnaire variable (Z-stat)	.9625 (-0.57)	.9412 (-0.97)	1.2500*** (3.83)	1.0237 (.038)	1.1646** (2.33)
Control variables					
TLI x age (Z-stat)	1.1190*** (3.89)	1.1173*** (3.94)	1.1339*** (4.80)	1.1346*** (4.72)	1.1368*** (4.84)
TLI x stop loss user (Z-stat)	1.5825*** (6.84)	1.5776*** (6.82)	1.5602*** (6.65)	1.5827*** (6.85)	1.5791 (6.83)
TLI x self rated expertise (Z-stat)	.9326 (-1.27)	.9302 (-1.32)	.8706** (-2.41)	.9349 (-1.20)	.9001* (-1.83)
Questionnaire variable (Z-stat)	1.0049 (0.13)	.9592 (-1.17)	.8922*** (-3.58)	.8384*** (-5.27)	.8435*** (-4.79)
Age (Z-stat)	.7838*** (-7.71)	.7760*** (-8.02)	.7791*** (-8.05)	.7735*** (-8.20)	.7765*** (-8.10)
Age x log time (Z-stat)	1.0551*** (6.34)	1.0556*** (6.40)	1.0552*** (6.34)	1.0550*** (6.27)	1.0547*** (6.25)
Stop loss user (Z-stat)	1.1517*** (3.70)	1.1522*** (3.73)	1.1597*** (3.89)	1.1411*** (3.46)	1.1514*** (3.71)
Self rated expertise (Z-stat)	1.1511*** (4.53)	1.1497*** (4.51)	1.1959*** (5.45)	1.1936*** (5.56)	1.2049*** (5.74)
***, **, * - significant at 1,5 and 10% level					

Table 7:6 Trading gain indicator with the REI scales and subscales when control variables are considered

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Questionnaire variable	Experiential	Experiential ability	Rational preference	Rational ability	Rational
TGI (Z-stat)	1.7869** (1.97)	1.3831 (1.17)	4.776*** (7.00)	2.0336*** (2.70)	3.3815*** (4.76)
TGI x questionnaire variable (Z-stat)	1.1367** (2.04)	1.2161*** (3.32)	.8603*** (-2.79)	1.1072* (1.80)	.9660 (-0.57)
Control variables					
TGI x age (Z-stat)	.9544* (-1.78)	.9627 (-1.48)	.9284*** (-3.11)	.9356*** (-2.74)	.9303*** (-2.99)
TGI x stop loss user (Z-stat)	.5325*** (-9.91)	.5397*** (-9.74)	.5440*** (-9.60)	.5492*** (-9.42)	.5428*** (-9.63)
TGI x self rated expertise (Z-stat)	1.0978* (1.80)	1.0955* (1.77)	1.1374** (2.37)	1.0629 (1.15)	1.0934* (1.66)
Questionnaire variable (Z-stat)	.9199* (-1.75)	.8455*** (-3.83)	1.0413 (1.00)	.8052*** (-5.18)	.9057** (-2.20)
Age (Z-stat)	.8030*** (-6.37)	.7912*** (-6.82)	.8162*** (-6.09)	.8034*** (-6.45)	.8120*** (-6.18)
Age x log time (Z-stat)	1.0665*** (7.69)	1.0674*** (7.79)	1.0662*** (7.63)	1.0676*** (7.71)	1.0662*** (7.59)
Stop loss user (Z-stat)	1.8928*** (13.37)	1.8743*** (13.21)	1.8785*** (13.25)	1.8434*** (12.78)	1.8741*** (13.19)
Self rated expertise (Z-stat)	1.0683* (1.69)	1.0675* (1.68)	1.0663 (1.58)	1.1278*** (3.03)	1.1088** (2.56)
***, **, * - significant at 1,5 and 10% level					

7.1.4 Different influence on the disposition effect by the rational and experiential subscales

The analysis of the subscales illustrated that there are significant differences between the preference and ability dimensions in curbing the disposition effect. Specifically, the experiential preference subscale had no influence, yet the experiential ability subscale increased the disposition effect. The rational preference subscale decreased the disposition

effect whilst the rational ability subscale increased the disposition effect. The difference in the rational subscales is of more concern as they illustrate an antagonistic relationship on the disposition effect. So a discussion of why the subscales have a different influence on the disposition effect and what relevance this has, is presented next.

One possible reason for the different influences of the subscales on the disposition effect is that each subscale is measuring an inherently different aspect of cognition. Pacini and Epstein (1999) argued that the subscales do measure a discernible difference because their research shows that the subscales have different correlations with various personality measures. However, the rational subscales do not have opposite correlations with the various personality measures, so Pacini and Epstein's (1999) research does not support the contrary influence that the rational subscales have on the disposition effect. Furthermore, Hogkinson et al (2009) assessed the suitability of subscale classification by using principal component analysis. They found no discernible difference between the subscales, advising against using the ability and preference distinctions.

Another possible reason for the subscales having a different influence on the disposition effect is that the measurement validity of the rational preference and experiential ability subscales is better than that of the rational ability and experiential preference subscales. In other words, the rational preference subscale is a more apt measure of system 2 cognition than the rational ability subscale. Also the experiential ability subscale is a more apt measure of system 1 cognition than the experiential preference scale. As mentioned earlier, the rational preference and experiential ability scales were developed in the original REI (Epstein et al., 1996) with the rational ability subscale and experiential preference subscale

being added subsequently (Pacini and Epstein, 1999). This thesis found that these original items were more pertinent in explaining variation in the disposition effect than the newly added subscales. Furthermore, Chapter 5 showed the distribution of these scales and this may be relevant to this discussion. It showed that the rational ability subscale was negatively skewed but the rational preference subscale was closer to a normal distribution. This suggests that there may be social desirability bias occurring with responses to the rational ability subscale but less so for the rational preference subscale. This could be a cause of the antagonistic relationship of the rational subscales on the disposition effect.

Whilst it is not possible nor the aim of this research to assess the validity these subscales, it is of some relevance when interpreting results using them. If it is assumed that the rational preference subscale more aptly measures individual differences in system 2 cognition, then the results show robust support for system 2 cognition reducing decision making bias. If it is assumed that the rational ability subscale is an apt measure of system 2 cognition, then there is a contrary result which suggests that system 2 cognition increases the disposition effect. Finally, if it is assumed that the rational scale is an apt measure of system 2 cognition, then it only decreases the probability of holding losses, when control variables are considered. For the reasons of social desirability bias and because there is a significant influence of the rational scale when control variables are included, this thesis assumes that rational preference is a measure of system 2 cognition.

7.1.5 Discussion of findings for dual process theory and the disposition effect

7.1.5.1 System 1 cognition

In Chapter 3, hypothesis 9 predicted that investors with a preference towards system 1 cognition would be more susceptible to the disposition effect. This hypothesis is based on the theory that system 1 processes lead to more bias in decision making and cause deviations from normatively rational decisions (Kahneman, 2003, Kahneman and Frederick, 2005). The findings above support this hypothesis as they show that investors who score high on the experiential scale are more likely to sell gains sooner. Research on the disposition effect has tended to focus on demographic variables which reduce susceptibility to this bias (Brown et al., 2006, Chen et al., 2007, Dhar and Zhu, 2006, Feng and Seasholes, 2005, Seru et al., 2010). This research makes a contribution to knowledge on the disposition effect by showing that individual differences in system 1 cognition has an influence at increasing susceptibility to this bias.

The findings also have relevance for literature on dual process theory in decision making. Kahneman (2003) and Kahneman and Frederick (2007) posit that decision making bias occurs from system 1 processes because heuristics and bias research has shown that intuitive judgements deviate from normatively rational decision making. However, this research has been critiqued by Gigerenzer and colleagues (Gigerenzer, 2004, Gigerenzer et al., 1999) who argue that the use of heuristics can make optimal decisions and improve decision making performance when taken outside of the laboratory. Likewise, Klein and colleagues (1999, Lipshitz et al., 2001, Phillips et al., 2004) argue that professional decision makers use intuition to make optimal decisions. This research contributes to this debate by showing an empirical relationship between a common investment decision making bias and

system 1 cognition. Furthermore, the findings of this thesis are based on data from actual investment decisions which endorses ecological validity for dual process theory of decision making. It is important to note that findings of this thesis are based on non-professional investors. It is very possible that professional traders use of system 1 based judgements may not be related to decision making bias.

7.1.5.2 System 2 cognition

The other aspect of the dual process theory in decision making is the use of system 2 cognitive processes. If system 2 processes are adopted, and they have the computation ability, it is hypothesized that they can overcome bias in decision making and move decisions closer to those of normative rationality (Kahneman, 2003, Kahneman and Frederick, 2005). So, hypothesis 9 in Chapter 3 predicted that investors higher in system 2 cognition would be less susceptible to the disposition effect. Initial results suggested that there was no relationship between system 2 cognition and the disposition effect but after exploring the data it was found that the rational subscales have antagonistic effects on the disposition effect. That is, the rational preference subscale decreased the disposition effect whilst the rational ability subscale increased the disposition effect. The influence of the rational scale was significant when control variables were included in the regression. This thesis makes an original contribution to knowledge about the disposition effect by showing that a new variable reduces susceptibility to this bias. It utilises psychological theories of decision making theory to show that individual differences in system 2 cognitive processes help explain the extent to which an investor exhibits this bias. Furthermore, it makes a contribution to knowledge by using a different methodology. Other research which has incorporated psychological explanations of the disposition effect have used an

experimental methodology (Chui, 2001, Lee et al., 2008, Summers and Duxbury, 2012). This thesis contributes to this area of research by showing the relevance of psychological theories to the disposition effect using actual investment data.

This finding also makes a contribution to dual process theories of decision making. Research in this area has attempted to show that individuals higher in system 2 based cognition make less decision making bias (Frederick, 2005, Kogler and Kühberger, 2007, Pacini and Epstein, 1999, Stanovich and West, 1998). There has been particular interest in the relationship between system 2 cognition and less susceptibility to the framing and reflection effects (Bjorklund and Backstrom, 2008, Simon et al., 2004, Smith and Levin, 1996, LeBoeuf and Shafir, 2003, Levin et al., 2002, Levin et al., 1998, Shiloh et al., 2002). This thesis contributes by showing that individual differences in reliance on system 2 cognition is related to an investment decision making bias.

7.2 Findings for emotion regulation and the disposition effect

This section reports the findings for susceptibility to the disposition effect based on individual differences in two emotion regulation strategies; reappraisal and expressive suppression. Hypothesis 10 predicted that reappraisal would decrease the disposition effect and hypothesis 11 predicted that expressive suppression would increase the disposition effect. This section begins by outlining the influence that reappraisal and expressive suppression have on the probability of holding losses and gains. Then, the analysis is repeated with control variables, to determine whether the results are robust. Finally, a discussion of the results is presented.

7.2.1 Reappraisal

Regression 1 in Table 7:7 and Table 7:8 outline the results for the influence of reappraisal on the probability of holding losses and gains, respectively. The hazard rate for the interaction between the TLI and reappraisal is significant and above 1 ($h(t) = 1.0788$ $p < .01$). This shows that the probability of holding losses, relative to baseline, decreases for those investors with higher scores in reappraisal. Regression 1 in Table 7:8 shows that the hazard rate for the interaction between the TGI and reappraisal is insignificant ($h(t) = .9970$, $p = .928$). This shows that a significant relationship between reappraisal and the probability of holding gains cannot be detected in this data. Overall, these initial results support hypothesis 10, that investors higher in reappraisal are less susceptible to the disposition effect because they have a higher probability of selling losses.

7.2.2 Expressive suppression

Regression 2 in Table 7:7 and Table 7:8 outline the results for the influence that expressive suppression has on the probability of holding losses and gains, respectively. The hazard rate for the interaction between the TLI and expressive suppression is insignificant ($h(t) = 1.0442$, $p = .186$) indicating that a significant relationship between the probability of holding losses and expressive suppression cannot be detected in this data. However, the hazard rate for the interaction between the TGI and expressive suppression is significantly below 1 ($h(t) = .9143$, $p < .01$) indicating that the probability of holding gains, relative to baseline, increases for those investor with higher scores in expressive suppression. These initial results contradict hypothesis 11 and show that investors who are higher in expressive suppression are less likely to exhibit the disposition effect because they have a higher probability of holding gains.

Table 7:7 Trading loss indicator with reappraisal and expressive suppression

	Reg 1	Reg 2	Reg 3
TLI (Z-stat)	.3626*** (-6.11)	.4328*** (-6.29)	.2939*** (-5.60)
TLI x reappraisal (Z-stat)	1.0788** (2.16)		1.0832*** (-2.27)
TLI x expressive suppression (Z-stat)		1.0442 (1.32)	1.0501 (1.49)
Control variables			
Reappraisal (Z-stat)	.8669*** (-7.30)		.8652*** (1.49)
Expressive suppression (Z-stat)		.9858 (-0.78)	.9752 (-1.37)
***, **, * - significant at 1,5 and 10% level			

Table 7:8 Trading gain indicator with reappraisal and expressive suppression

	Reg 1	Reg 2	Reg 3
TGI (Z-stat)	2.0409*** (4.61)	2.8649*** (8.47)	3.0484*** (5.48)
TGI x reappraisal (Z-stat)	.9970 (-.09)		.9891 (-.33)
TGI x expressive suppression (Z-stat)		.9143*** (-2.92)	.9107*** (-3.04)
Control variables			
Reappraisal (Z-stat)	.8903*** (-4.59)		.8929*** (-4.45)
Expressive suppression (Z-stat)		1.0497** (2.11)	1.0422* (-1.79)
***, **, * - significant at 1,5 and 10% level			

7.2.3 Reappraisal and suppression with control variables

The next analysis includes control variables to ascertain whether the relationship between these emotion regulation strategies and the disposition effect will still be significant when other relevant variables are considered in the analysis. The control variables included are the same as those used in the previous analysis, which are age, stop loss user and self-rated

expertise. Other control variables and combinations of control variables were trialled. Whilst slightly different results were found, the interpretation of the results did not change. The use of log estimated cumulative trades, gender and sophistication (measured by investors who trade complex products) as control variables are outlined in appendix 8. The influence of reappraisal and expressive suppression, when control variables are considered, on the probability of holding losses and gains are outlined in Table 7:9 and Table 7:10, respectively.

7.2.3.1 Reappraisal with control variables

The influence that reappraisal has on the probability of holding losses, when control variables are considered, is presented in regression 1 of Table 7:9. It shows that the hazard rate for the interaction between the TLI and reappraisal is above 1 ($h(t) = 1.0631$ $p = 0.079$), but significant only at the 10% level. This shows that the probability of holding losses, relative to baseline, decreases for those investors with high scores on reappraisal, but the significance of this relationship reduces when other variables are considered. The influence that reappraisal has on the probability of holding gains, relative to baseline, when control variables are considered is presented in Regression 1 in Table 7:10. The interaction between the TGI and reappraisal is insignificant ($h(t) = .9966$, $p = .918$). This result remains unchanged and shows that a significant relationship between reappraisal and the probability of holding gains cannot be detected in this data. Overall, there is tentative support for hypothesis 10, that reappraisal decreases the disposition effect because investors higher in reappraisal have a lower probability of holding losses.

7.2.3.2 Expressive suppression with control variables

The influence that expressive suppression has on the probability of holding losses, when control variables are considered, is presented in regression 2 of Table 7:9. The hazard rate for the interaction between the TLI and expressive suppression is insignificant ($h(t) = .9857$ $p=.664$), indicating that a relationship between expressive suppression and the probability of losses, relative to baseline, cannot be detected when control variables are considered.

The influence of expressive suppression on the probability of holding gains, when control variables are considered, is outlined in regression 2 of Table 7:10. The interaction between the TGI and expressive suppression is insignificant ($h(t)=.9687$, $p= .308$), indicating that a relationship between expressive suppression and the probability of holding gains, relative to baseline, cannot be detected when these control variables are considered. This last result represents a change from when expressive suppression was analysed by itself. It implies that the previous finding, which found that expressive suppression is associated with a decrease in the disposition effect, is not robust. Overall, there is no evidence to support hypothesis 11, that investors higher in expressive suppression will exhibit the disposition effect to a greater extent.

Table 7:9 Trading loss indicator with reappraisal and expressive suppression when control variables are included

	Reg 1	Reg 2
Questionnaire variable	Reappraisal	Expressive suppression
TLI (Z-stat)	.2266*** (-6.72)	.3167*** (-5.61)
TLI x questionnaire variable (Z-stat)	1.0631* (1.76)	.9857 (-.043)
Control variables		
TLI x age (Z-stat)	1.1420*** (4.98)	1.1280*** (4.57)
TLI x stop loss user (Z-stat)	1.6183*** (7.18)	1.5871*** (6.84)
TLI x self-rated expertise (Z-stat)	.9113* (-1.70)	.9330 (-1.27)
Questionnaire variable (Z-stat)	.8480*** (-8.30)	.9828 (-.93)
Age (Z-stat)	.7701*** (-8.39)	.7822*** (-7.95)
Age x log time (Z-stat)	1.0567*** (6.48)	1.0558*** (6.41)
Stop loss user (Z-stat)	1.1418*** (3.49)	1.1569*** (3.81)
Self-rated expertise (Z-stat)	1.1938*** (5.68)	1.1498*** (4.52)
***, **, * - significant at 1,5 and 10% level		

Table 7:10 Trading gain indicator with reappraisal and expressive suppression when control variables are included

Questionnaire variable	Reappraisal	Expressive suppression
TGI (Z-stat)	3.0069*** (5.33)	3.3706*** (6.43)
TGI x questionnaire variable (Z-stat)	.9966 (-.10)	.9687 (-1.02)
Control variables		
TGI x age (Z-stat)	.9257*** (-3.20)	.9354*** (-2.79)
TGI x stop loss user (Z-stat)	.5308*** (-10.00)	.5414*** (-9.61)
TGI x self-rated expertise (Z-stat)	1.1044* (1.93)	1.0807 (1.51)
Questionnaire variable (Z-stat)	.8701*** (-5.58)	.9930 (-0.30)
Age (Z-stat)	.8063*** (-6.38)	.8138 (-6.18)
Age x log time (Z-stat)	1.0693*** (7.93)	1.0670*** (7.71)
Stop loss user (Z-stat)	1.9009*** (13.48)	1.8842*** (13.16)
Self-rated expertise (Z-stat)	1.0950** (2.36)	1.0792** (1.98)
***, **, * - significant at 1,5 and 10% level		

7.2.4 Discussion about results for reappraisal and suppression

7.2.4.1 Reappraisal

The initial results for the relationship between reappraisal and the disposition effect showed that high reappraisal is associated with less susceptibility to this bias. However, when control variables were included, the significance of this result decreased. Overall there is enough evidence to tentatively support hypothesis 10, that investors who are higher in reappraisal will be less susceptible to the disposition effect. Interestingly, reappraisal did not have any influence on the probability of holding gains, suggesting that emotion regulation is more relevant to the holding losses aspect of the disposition effect. It would

seem that reappraisal primarily reduces the loss aversion component of the disposition effect rather than the risk aversion component. This may occur as people are more likely to tend to the negative emotions associated with a loss than the positive emotions associated with a gain.

This finding contributes to literature on the disposition effect by showing that emotion regulation influences the disposition effect. Previous research on the disposition effect has found that emotions (Summers and Duxbury, 2012) and hedonic editing (Kumar and Lim, 2008) can have a significant influence on the disposition effect. This research finds that the method with which investors regulate their emotions also has a marginally significant influence on susceptibility to this bias. Research on emotions in investment decision making, but not specifically on the disposition effect, has found that emotions are sometimes beneficial (Seo and Barrett, 2007) and sometimes detrimental (Lo et al., 2005) to decision making performance. It was argued in Chapter 3 that focusing on whether emotions are bad or good for decision making is not the right perspective to explore emotions relevance for investment decision making. Instead the focus should consider emotion regulation. The findings for reappraisal suggest that caution should be used when taking this perspective.

Research on decision making performance has investigated how reappraisal emotion regulation strategies influences decision making. Sokol-Hessner et al. (2009) found that reappraisal reduces loss aversion, Heilman et al. (2010) found that reappraisal was effective at down regulating the influence of fear in risky decisions and van't Wout et al. (2010) found that reappraisal was likely to increase the tendency to accept lower monetary

rewards. All of this research suggests that reappraisal is connected with an acceptance of adverse scenarios. This research contributes to these findings by tentatively showing that investors who are higher in reappraisal are more likely to accept losses. This could imply that using reappraisal allows investors to come to terms with losing money and then act accordingly. Furthermore, this thesis shows the relevance for emotion regulation in a real life setting, unlike the other research which has used experimental designs. Similarly, Fenton-O'Creevy et al. (2011a) found similarities between the emotion regulation strategies adopted by expert traders and reappraisal using qualitative data. This thesis contributes to these findings by showing that reappraisal may be relevant to reducing bias in non-professional investors using quantitative data.

7.2.4.2 *Expressive suppression*

The findings for the relationship between expressive suppression and the disposition effect initially suggest that expressive suppression is associated with an increase in the probability of holding gains. This is the opposite of hypothesis 11, which predicted that investors who scored higher in expressive suppression emotion regulation would exhibit the disposition effect to a greater extent. Subsequent analysis showed that this relationship could not be detected when control variables are considered. Overall, there is no support for hypothesis 11 with this data. It is possible that there is a relationship between expressive suppression and susceptibility to disposition effect, but the data used in this analysis is not big enough to detect it. However, because this thesis found significant findings for other psychological variables, it implies that if a relationship does exist, a larger sample size is needed to detect it.

This finding contributes to knowledge on the disposition effect by showing that expressive suppression emotion regulation does not have a robust influence on the disposition effect in this sample. It also contributes to the decision making literature which investigates the influence of expressive suppression on decision making bias. Often the influence of reappraisal and expressive suppression are compared because Gross (1998) regards the former as an antecedent strategy and the latter as a response driven strategy. It has been shown that these two strategies have a significant influence on the emotion being experienced, cognition and social consequences (Gross and John, 2003, John and Gross, 2004, John and Gross, 2007). This research suggests that whilst there are differences for a particular decision making bias, these differences are driven by reappraisal rather than expressive suppression.

7.3 Estimate of variance explained by psychological variables

This final section of analysis estimates how much variance in the disposition effect is explained by dual process theory and emotion regulation. The analysis above showed that the experiential scale, experiential ability subscale, rational preference subscale and reappraisal all had a significant influence on the disposition effect. The next subsection estimates the variance explained by the experiential scales. The following subsection estimates the variance explained by the rational preference subscale and reappraisal in addition to age and stop loss user.

7.3.1 Variance explained by the experiential scale and experiential ability subscale

The experiential scale and experiential ability subscale both increased the disposition effect. It is difficult to estimate the amount of variance explained by these variables in addition to the demographic variables because none of the demographic variables significantly increased the disposition effect. Nonetheless, it is possible to estimate the variance explained by the experiential scale and experiential ability subscale by themselves. The variance explained by each scale can be estimated by comparing the hazard rate of an investor who scored very high to an investor who scored very low. Using the actual mean and standard deviation of the scale, I use a score of two standard deviations below the mean to represent an investor who scored very low and use two standard deviations above the mean to represent someone who scored very high.

The estimated hazard rate for the TLI of an investor who scored 4.34 (two standard deviations above the mean) on the experiential scale is 0.4285 ($0.8432 \times 0.8556^{4.34}$). Whereas, the hazard rate for the TLI of an investor who scored 2.15 (two standard deviations below the mean) on the experiential scale is 0.6030 ($0.8432 \times 0.8556^{2.15}$). This represents an increase of 28.94% $((.4285-.6030)/.4285)$ in the probability of holding losses, relative to baseline, over four standard deviations of the experiential scale. In relation to gains, the estimated hazard rate for the TGI of an investor who scored 4.34 on the experiential scale is 2.399 ($1.3281 \times 1.1394^{4.34}$). The estimated hazard rate for the TGI of an investor who scored 2.15 on the experiential scale is 1.7583 ($1.3281 \times 1.1394^{2.15}$). This

represents a decrease of 36.44% $((2.399-1.7583)/1.7583)$ in the probability of holding gains, relative to baseline, over four standard deviations of the experiential scale.

The experiential ability subscale explains a similar amount of variance to experiential scale.

The estimated hazard rate for the TLI of an investor who scored 4.46 of the experiential ability subscale is 0.4013 $(0.9637 \times 0.8217^{4.46})$. Whereas, the hazard rate for the TLI of an investor who scored 2.19 on the experiential ability subscale is 0.6268 $(0.9637 \times 0.8217^{2.19})$.

This represents an increase of 56.19% $((.4013 -.6268)/.4013)$ in the probability of holding losses, relative to baseline, over four standard deviations of the experiential ability subscale.

In relation to gains, the estimated hazard rate for the TGI of an investor who scored 4.46 on the experiential ability subscale is 2.7234 $(.9174 \times 1.2763^{4.46})$. The estimated hazard rate for the TGI of an investor who scored 2.19 on the experiential scale is 1.5652 $(.9174 \times 1.2763^{2.19})$. This represents an increase of 74.00% $((2.7234 - 1.5652)/1.5652)$ in the probability of holding gains, relative to baseline, over four standard deviations of the experiential ability subscale. Overall, the experiential ability subscale explains more variance in the disposition effect than the experiential scale. Also, both scales explain a larger amount variance for probability of holding gains than they do for the probability of holding losses.

7.3.2 Variance explained by reappraisal scale and rational preference subscales

Both the reappraisal scale and rational preference subscale had a significant influence on the probability of holding losses and the rational preference subscale also had a significant influence on the probability of holding gains. So it is possible to estimate about the amount of variance explained by these variables in addition to the demographic variables. The

method of calculating the amount of variance explained by these variables is to run a regression which includes both reappraisal and rational preference subscale to ascertain if they both explain unique variance in the disposition effect. Then a regression is run which includes both reappraisal and the rational preference subscale with other variables which have a decreasing influence on the disposition effect. These other variables were identified in section 3 of Chapter 6, as being age and stop loss user. An estimated hazard rate for the psychological variables with age and stop loss user can be compared to an estimated hazard rate for age and stop loss user. This will indicate how much extra variance the psychological variables explain in the disposition effect.

The results of this estimation for trading losses are presented in Table 7:11. Regression 1 shows the influence that reappraisal and rational preference have on trading losses when combined. The hazard rate for the interaction between the TLI and rational preference subscale is significantly above 1 ($h(t) = 1.1785$, $p < .01$) but the hazard rate for the interaction between the TLI and reappraisal is significant at the 10% level ($h(t) = 1.0602$, $p = .097$). This indicates that the influence of reappraisal on the probability of holding losses, relative to baseline, drops in significance when rational preference is included. This may occur because there is a positive correlation between reappraisal and rational preference ($r = .1689$, $p < .01$). Regression 2 includes the TLI with reappraisal, rational preference, age and stop loss user. However, the amount of variance explained by these variables cannot be estimated because the hazard rate for the interaction between the TLI and reappraisal is insignificant ($h(t) = 1.0275$, $p = 0.436$). For this reason, reappraisal is dropped from the regression.

Regression 3 shows the extent to which rational preference, age and stop loss user decrease the probability of holding losses. Using this regression it is possible to estimate the TLI hazard rate of certain investors. For example, a 68 year old investor, who uses stop losses and scored 4.96 (two standard deviations above the mean) on the rational preference scale, has an estimated TLI hazard rate of .8985 ($.1303 \times 1.1951^{4.96} \times 1.1312^5 \times 1.5379$). In Chapter 6, it was outlined that the hazard rate for a 68 year old investor who uses stop losses is .7317. This means that being two standard deviations above the mean on the rational preference subscale decreases the probability of holding losses by 22.80% $((.8985 - .7317) / .7317)$. Furthermore, if an investor scores lowly on the rational preference subscale, their probability of holding losses increases dramatically. For example, if the same 68 year old investor who uses stop losses and has a score of 2.44 (two standard deviations below the mean) on the rational preference subscale their estimated TLI hazard rate is .5734 ($.1303 \times 1.1951^{2.44} \times 1.1312^5 \times 1.5379$). The variation in probability of holding losses, relative to baseline, explained by 4 standard deviations of the rational preference scale, when age and stop loss use are considered, is 56.70% $((.8985 - .5734) / .5734)$.

Table 7:11 Trading loss indicator with reappraisal, the rational preference subscale, age and stop loss user

	Reg 1	Reg 2	Reg 3
TLI (Z-stat)	.2103*** (-6.27)	.10928*** (-8.33)	.1303*** (-8.66)
TLI x rational preference (Z-stat)	1.1785*** (2.94)	1.1935*** (3.18)	1.1951*** (3.25)
TLI x reappraisal (Z-stat)	1.0602* (1.66)	1.0275 (0.78)	
TLI x age (Z-stat)		1.1449*** (5.12)	1.1312*** (4.73)
TLI x stop loss user (Z-stat)		1.5848*** (6.87)	1.5379*** (6.43)
Control variables			
Rational preference (Z-stat)	.9907 (-0.31)	.9842 (-0.52)	.9446* (-1.90)
Reappraisal (Z-stat)	.8678*** (-7.14)	.8637*** (-7.38)	
Age (Z-stat)		.7873*** (-7.72)	.7968*** (-7.37)
Age x log time (Z-stat)		1.0516*** (5.92)	1.0503*** (5.80)
Stop loss user (Z-stat)		1.1622*** (3.95)	1.1749*** (4.24)
***, **, * - significant at 1,5 and 10% level			

In regards to the amount of variation in the probability of holding gains, only the rational preference subscale is considered because it was the only psychological variable which had a robust influence. The regression which combines the TGI with the rational preference scale, age and stop loss user is located in Table 7:12 . From this it is possible to estimate the TGI hazard rate for certain investors. The estimated hazard rate for trading gains of a 68 year old investor, who uses stop losses and scored 4.96 on the rational preference scale is $1.2218 (5.4241 \times .8983^{4.96} \times .9297^5 \times .5521)$. As outlined in Chapter 6, the estimated hazard rate for a 68 year old investor who trades stop losses is 1.3859. Thus, being two standard deviations above the mean on the rational preference subscale increases the probability of holding gains by 11.84% $((1.3859 - 1.2218)/1.3859)$. Furthermore, lower scores on the

rational preference subscale have a significant influence on the probability of holding gains, relative to baseline. The same 68 year old investor who uses stop losses and scores 2.44 on the rational preference subscale has a trading gain hazard rate estimate of 1.6011 ($5.4241 \times .8983^{2.44} \times .9297^5 \times .5521$). An increase by four standard deviations of the rational preference scale results in a 31.04% $((1.6011 - 1.2218)/1.2218)$ increase in the probability of holding gains, relative to baseline, when age and stop loss user are considered.

Table 7:12 Trading gain indicator with the rational preference subscale, age and stop loss user

	Reg 1
TGI (Z-stat)	5.4241*** (7.79)
TGI x rational preference (Z-stat)	.8983** (-2.11)
TGI x age (Z-stat)	.9297*** (-3.06)
TGI x stop loss user (Z-stat)	.5521*** (-9.37)
Control variables	
Rational preference (Z-stat)	1.0621 (1.57)
Age (Z-stat)	.8295 (-5.64)
Age x log time (Z-stat)	1.0623 (7.20)
Stop loss user (Z-stat)	1.8778 (13.24)
***, **, * - significant at 1,5 and 10% level	

Overall, this analysis showed that the amount of variance in the disposition effect explained by the rational preference subscale is substantial, with a small change in this scale inducing a big change in susceptibility to the disposition effect. It also shows that the rational preference scale explains variance in the disposition effect in addition to age and stop loss user.

7.4 Conclusion

This chapter presented findings for susceptibility to the disposition effect based on psychological variables. The first section presented analysis of dual process theory. It showed that the experiential scale increased the disposition effect. However, when control variables were included, there was only a significant relationship between the experiential scale and the probability of holding gains. Overall, investors who reported higher levels of ability in system 1 cognition were more susceptible to the disposition effect.

Initially it seemed that the influence the rational scale had on the disposition effect could not be detected in this data because the results were insignificant. However, it was subsequently shown that the rational ability and rational preference subscales, which make up the rational scale, have an antagonistic influence on the disposition effect causing the main null result. The rational scale and rational ability subscale have a skewed distribution suggesting that social desirability bias may be contributing to this result, but there is no way of testing this theory. When control variables were included in the analysis, a significant result was found for the rational scale on the disposition effect. Also investors who reported higher scores on the rational preference subscale exhibited less disposition effect. These findings tentatively support the hypothesis that investors who report higher reliance on system 2 cognition show less susceptibility to the disposition effect.

The influence of emotion regulation on the disposition effect was explored in section 2 of this chapter. It was shown that reappraisal is related to a decrease in probability of holding

losses but there was no significant relationship observed with the probability of holding gains. When control variables were included, reappraisals relationship to the probability of holding losses remained but the significance of this result dropped to the 10% level. In total, there is evidence to tentatively support the hypothesis that reappraisal emotion regulation decreases the disposition effect. For expressive suppression, results initially showed that it decreased the probability of holding gains. When control variables were included in the analysis, this result became insignificant. This shows that there is no evidence showing that investors higher in expressive suppression exhibit the disposition effect to a greater extent.

The final section estimated the amount of variance explained by the psychological variables. It showed that an increase in the score on the experiential scale of four standard deviations resulted in a 28.94% increase in the probability of holding losses, relative to baseline, and a 36.44% decrease in the probability of holding gains, relative to baseline. An estimation of the variance explained by the rational preference subscale, in addition to the demographic variables, showed that being two standard deviations above the mean reduces the probability of holding losses by 22.81%, relative to baseline, and increases the probability of holding gains by 11.84%, relative to baseline.

Chapter 8. Summary of findings

The previous two chapters presented the results of this thesis. They showed evidence of the disposition effect and how susceptibility to it is related to investor sophistication, experience, stop loss strategies, dual process theory and emotion regulation. The purpose of this chapter is to offer a brief summary of these findings in relation to the research questions and hypotheses of this thesis. This thesis addressed three research questions and these are as follows:

Q1. To what extent do UK stock market investors exhibit the disposition effect?

Q2. To what extent do investor sophistication, investor experience and the use of stop loss strategies reduce the disposition effect of UK stock market investors?

Q.3 To what extent do individual differences in reliance on system 1 and system 2 cognition, and individual differences in the use of reappraisal and expressive suppression emotion regulation, relate to the disposition effect for UK stock market investors?

Table 8:1 Hypotheses with results

Hypothesis	Supported	Comments
H1: <i>In aggregate, investors in the UK will exhibit the disposition effect</i>	Yes	
H2: <i>Investors who trade more complex financial products will exhibit the disposition effect to a lesser extent</i>	Yes	The influence on the probability of holding losses was not significant when other variables are considered.
H3: <i>Older investors will exhibit the disposition effect to a lesser extent</i>	Yes	
H4: <i>Older investors will exhibit the disposition effect to a lesser extent whilst controlling for average trade value</i>	Yes	
H5: <i>Investors with more years of investment experience will exhibit the disposition effect to a lesser extent</i>	Yes	Results became insignificant when age was considered.
H6: <i>Investors with more cumulative trades will exhibit the disposition effect to a lesser extent</i>	Yes	Results for the probability of holding losses were insignificant when age was considered.
H7: <i>Investors who use stop losses will exhibit the disposition effect to a lesser extent</i>	Yes	
H8: <i>Investors who have a higher reliance on system 1 based cognition will exhibit the disposition effect to a greater extent</i>	Yes	Results for the probability of holding gains became insignificant when other variables were considered.
H9: <i>Investors who have a higher reliance on system 2 based cognition will exhibit the disposition effect to a lesser extent</i>	Tentatively	The rational ability subscale showed the opposite results than predicted but the rational preference subscale supported this hypothesis. Significant results were found for the influence of the rational scale on the probability of holding losses when other variables were included in the analysis.
H10: <i>Investors who are higher in reappraisal emotion regulation will exhibit the disposition effect to a lesser extent</i>	Tentatively	Only influences the probability of holding losses. Results dropped in significance when other variables were considered.
H11: <i>Investors who are higher in expressive suppression emotion regulation will exhibit the disposition effect to a greater extent</i>	No	

For each of these research questions, hypotheses were proposed in Chapter 2 and

Chapter 3. A review of these hypotheses and an overview of the findings pertaining

to them are outlined in Table 8:1. This chapter is split into three sections with each section relating to one of the research questions. The first section summarises the findings for the disposition effect in aggregate. The second section summarises the findings for the influence that investor sophistication, investor experience and stop loss strategies have on the disposition effect. The final section summarises findings for the influence that reliance on system 1 and system 2 cognition, and reappraisal and expressive suppression emotion regulation have on the disposition effect.

8.1 Disposition effect in aggregate

Behavioural finance research has shown ways in which investors make biased decisions (Daniel et al., 2002). One of these biases is the disposition effect where investors are reluctant to sell stocks at a loss, yet eager to sell stocks at a gain (Shefrin and Statman, 1985). Evidence for the disposition effect is robust with the bias being exhibited by individual investors from many different countries (refer to appendix 1 for a review). However, a gap in the literature is that there is no research on the disposition effect based on UK investors. The first study of this thesis found that a sample of UK investors exhibit the disposition effect. For the average investor in this sample, the probability of holding stock increases by 42% when the stock is at a loss and decreases by 70% when the stock is at a gain, relative to baseline. These findings support hypothesis 1.

8.2 Sophistication, experience and stop loss strategies

Research on the disposition effect has shown that not all investors are prone to this bias (Dhar and Zhu, 2006, Weber and Welfens, 2008). Thus, the attention of recent research has been to predict which investor is the least susceptible to this bias.

Research has tended to focus on sophistication, measured using demographic proxies, to explain susceptibility to this bias (Boolell-Gunesh et al., 2009, Brown et al., 2006, Dhar and Zhu, 2006, Feng and Seasholes, 2005, Leal et al., 2010, Seru et al., 2010). The literature review showed that there is no clear definition of sophistication and that the proxies used for sophistication are inconsistent between studies. I defined sophisticated investors as those with more technical knowledge and argued that knowledge of risk was most pertinent to reducing the disposition effect. The proxy used to measure sophistication is based on whether or not the investor had traded complex financial products (Boolell-Gunesh et al., 2009, Seru et al., 2010) because these investors had completed the appropriateness assessment. Hypothesis 2 predicted that investors who traded complex financial products would exhibit the disposition effect to a lesser extent than other investors. The results from the analysis supported this. Specifically, the probability of these investors holding losses decreases by 11% and the probability of holding gains increases by 15%, relative to baseline. This supports hypothesis 2. However, when additional variables were considered, the influence of sophistication on the probability of holding losses became insignificant. This may be due to only a few investors (N=79) being classified as sophisticated in this study.

As outlined in Chapter 2, a concept related to sophistication is experience, but I choose to consider experience separately to sophistication in this thesis. I argued that investor experience could be measured in three different ways; age (Dhar and Zhu, 2006), years of experience (Chen et al., 2007, Seru et al., 2010) and cumulative number of trades (Feng and Seasholes, 2005, Seru et al., 2010). In this thesis, I utilised all three methods of measuring investor experience with cumulative number of trades being estimated by multiplying current trading frequency with years of experience. One finding showed that age decreased the disposition effect. The results indicated that a 10 year increase in an investor's age is associated with an 11% decrease in the probability of holding losses and a 7% increase in the probability of holding gains, relative to baseline. These findings support hypothesis 3. A possible objection to this result is that age is correlated with wealth and research has found that wealthier investors (measured by average trade value) are less prone to the disposition effect (Brown et al., 2006). This thesis found that there is a correlation between the average trade value and age ($r_s=.24$, $p<.01$, $N= 261$). However, the influence of age on the disposition effect did not change when the average trade value was controlled for, supporting hypothesis 4.

Hypothesis 5 predicted that investors with more years of investment experience would exhibit less disposition effect and hypothesis 6 predicted that investors with more cumulative trades would exhibit less disposition effect. Both of these variables were measured using the questionnaire data, so a smaller sample of investors ($N=261$) was used for this analysis. Initially, the influence of both of these variables on the disposition effect was insignificant. However, when a log transform of the

variables was adopted, significant results were observed in the data. The findings show support for hypothesis 5, as a 1 point increase in log years of experience is associated with a 13% decrease in the probability of holding losses, and an 8% increase in the probability of holding gains, relative to baseline. There is also support for hypothesis 6, as a 1 point increase in log estimated cumulative trades is associated with an 8% decrease in the probability of holding losses and an 8% increase in the probability of holding gains, relative to baseline.

The three different methods of measuring investor experience were combined in an analysis to ascertain whether or not each measure explains unique variance in the disposition effect. When age and the log years of experience were both used in the same analysis, age had a significant influence on the disposition effect but the log years of experience did not. This suggests that age encapsulates the influence which the log years of investment experience has on the disposition effect, for this data.

When the analysis combined the log estimated cumulative trades and age, a different result was found for the probability of holding gains than was found for the probability of holding losses. For losses, the influence of age was significant but the log estimated cumulative trades was insignificant. However, for gains, the influence of log estimated cumulative trades remained significant and age became insignificant. This suggests that experience measured by age is effective at reducing the reluctance to sell losses but experience measured by log estimated cumulative trades is effective at curbing the eagerness to sell gains.

A gap identified in the literature is that there has been no research into the effectiveness of stop losses at inoculating against the disposition effect. Hypothesis 7 predicted that stop loss strategies would be an effective tool to inoculate against the disposition effect. The analysis compared the disposition effect levels of those investors who adopted a stop loss strategy, to those who did not. For stop loss users, the probability of holding losses decreases by 13% and probability of holding gains increases by 25%, relative to baseline. These results showed that stop loss users are less susceptible to the disposition effect than other investors. Furthermore, the analysis of stop loss transactions showed that the effectiveness of stop losses is dramatic. The results showed a reverse disposition effect for all the roundtrip transactions in which stop losses were used. In other words, stocks were *more* likely to be sold at a loss than at a gain if a stop loss was used. These results supported hypothesis 7.

8.3 Dual process theory and emotion regulation

An aim of this thesis is to examine the extent to which two different theories can explain susceptibility to the disposition effect: one based on dual process theory and the other on emotion regulation. The results for dual process theory are summarised first, followed by those for emotion regulation.

Hypothesis 8 predicted that investors higher in system 1 cognition would be more susceptible to the disposition effect. The experiential scale of the REI was used to measure individual differences in system 1 cognition. The findings showed that a 1-point increase in an investor's score on the experiential scale is associated with a

14% increase in the probability of holding losses and a 14% decrease in the probability of holding gains, relative to baseline. When age, stop loss use and self-rated investment ability were included in the analysis, the relationship between the experiential scale and the probability of holding losses became insignificant, but the relationship remained significant for the probability of holding gains. There is a moderate negative correlation between age and the experiential scale ($r = -0.30$, $p < .01$, $N = 261$). This could explain why the relationship between trading losses and system 1 cognition is insignificant when the other variables are considered. Overall, these findings support hypothesis 8. Analysis of the experiential subscales was conducted to ascertain whether self-rated ability or self-rated preference for system 1 cognition is related to the disposition effect. This analysis showed that it is self-reported system 1 ability, rather than preference, that is associated with an increased disposition effect. This suggests that it is an investor's strong belief in their intuitive ability that increases the disposition effect.

Hypothesis 9 predicted that system 2 cognition would decrease the disposition effect with the rational scale of the REI being used to measure system 2 cognition. Initially, the analysis did not find evidence to support this hypothesis because there is no relationship between system 2 cognition and the disposition effect. However, an interesting relationship was found between the rational subscales and the probability of holding gains. This is that the rational preference subscale is associated with a decrease in the probability of holding gains and the rational ability subscale is associated with an increase in the probability of holding gains, relative to baseline. Thus, the subscales have an antagonistic relationship with the gains aspect

of the disposition effect, causing the rational scale to have insignificant results. In relation to losses, the rational scale decreased the probability of holding losses when age, stop loss use and self-rated investment ability were included in the analysis. This suggests tentative support for hypothesis 9. Also the rational preference subscale reduced the disposition effect. For every 1-point increase in an investor's score on the rational preference subscale, the probability of holding losses decreased by 20% and the probability of holding gains increased by 11%, relative to baseline. This result was also robust when age, stop loss user and self rated expertise were included in the analysis. These results show more tentative support for hypothesis 9.

Two methods of emotion regulation were also considered: reappraisal and expressive suppression. Hypothesis 10 predicted that individuals who are higher in reappraisal emotion regulation would exhibit the disposition effect to a lesser extent. The results show very tentative support for this hypothesis because reappraisal had a significant relationship with the probability of holding losses. There was no significant relationship observed between the probability of holding gains and reappraisal. For every 1-point increase in an investor's score on the reappraisal scale, the probability of holding losses decreases by 8%, relative to baseline. When age, stop loss use and self rated expertise investment are included, this relationship remains the same but drops to the 10% level of significance. Thus, the results only tentatively support hypothesis 10.

Finally, Hypothesis 11 predicted that investors who are higher in expressive suppression are more likely to exhibit the disposition effect. The results showed that the relationship between expressive suppression and the probability of holding losses was the opposite of what was hypothesised. Expressive suppression increased the tendency to sell losses. For every 1-point increase in an investor's score on the expressive suppression scale, the probability of holding losses decreased by 8%, relative to baseline. However, when age, stop loss use and self-rated investment ability were included in the analysis, the relationship between expressive suppression and the disposition effect was not significant. Overall, there is no evidence to support hypothesis 11.

8.4 Conclusion

This chapter summarised the findings of this thesis and began by outlining that UK investors are prone to the disposition effect. The thesis also finds that investor sophistication, investor experience and stop loss strategies all decreased the disposition effect of UK investors. These results showed evidence that system 1 cognition is associated with an increased tendency to exhibit the disposition effect and tentative support that system 2 cognition decreases the disposition effect. Finally, there is very tentative support that reappraisal decreases the disposition effect but no support was found for the hypothesised relationship between expressive suppression and an increased tendency to exhibit the disposition effect.

Chapter 9. Contribution, implications, limitations and future

The previous chapter gave a summary of the findings for this thesis. The purpose of this chapter is to reflect on these findings in a wider context. The chapter is split into three sections. The first section explains the contributions to knowledge for academic researchers. The second section discusses the limitations of this research and identifies options for future research. The third section offers practical implications of this research for investors, brokerage firms, UK policy makers and decision makers in general.

9.1 Research contributions

As outlined in Chapter 1, the assumptions of neo-classical economics underlying traditional finance models assume that investor's are rational (Fama, 1965, Ross, 2005). Research in the area of behavioural finance seeks to explain anomalies to these predictions by utilising decision making theories (Glaser et al., 2004). One anomaly identified by behavioural finance is the disposition effect which shows that investors sell winners too early and ride losers too long (Shefrin and Statman, 1985). Evidence of the disposition effect is robust with the bias being demonstrated in both experimental (Chui, 2001, Summers and Duxbury, 2012, Weber and Camerer, 1998) and field research (Odean, 1998, Shefrin and Statman, 1985). However, evidence of this bias has not been observed for UK investors. This thesis is the first study to show that UK individual investors are susceptible to this bias.

Research on the disposition effect has progressed from showing evidence of the bias (Odean, 1998) to predicting which investors are more or less susceptible to it (Dhar and Zhu, 2006). Research has shown that investor sophistication and investor experience reduce susceptibility to this bias (Dhar and Zhu, 2006, Feng and Seasholes, 2005, Seru et al., 2010, Boolell-Gunesh et al., 2009, Brown et al., 2006). However, the concept of investor sophistication is never clearly defined in the literature and ambiguity around this concept is increased by the different proxies used to estimate it. This thesis defines sophistication as pertaining to technical knowledge and argued that the knowledge of most relevance is an understanding of the risks associated with financial products. By researching the disposition effect of investors who have passed the appropriateness assessment, this thesis shows that these sophisticated investors are less susceptible than others to this bias. Thus, it contributes to existing knowledge by showing that investors with more technical knowledge show less disposition effect. It cannot specifically show that it is knowledge of risk that reduces the disposition effect, but this could be an area of interest for future research.

This thesis confirms the relationship between investor experience and the disposition effect. Prior research has found that years of experience and the number of cumulative trades reduce the disposition effect, with the latter variable being more effective (Feng and Seasholes, 2005, Seru et al., 2010). This research also found that the relationship between experience and the disposition effect is not linear. Log transformations of years of experience and estimated cumulative trades were required to obtain significant results. This suggests that early experience is

more relevant than later experience at reducing susceptibility to the disposition effect. Other research on investor experience has not used log transformations of these variables and therefore, this is a unique contribution made by this thesis. An investor's age is also correlated with experience and this had a large influence on the disposition effect. When investor experience and age were combined in this analysis, age was generally more predictive of differences in the disposition effect. This finding suggests that experience from outside of investing may also be important at reducing the disposition effect. It is also possible that older investors have different attitudes towards investment which, in turn, reduces the disposition effect. Overall, the findings of this thesis show that future research on the influence of investor experience on the disposition effect should also consider age.

This thesis is the first research to show that stop loss strategies can inoculate against the disposition effect. Prior academic research on stop losses has shown that they are a non-optimal method of investing for a rational investor (Dybvig, 1988, Gollier, 1997). This thesis takes a different perspective because it shows that investors are not rational decision makers, they are prone to the disposition effect. It also shows that investors who use stop losses can inoculate against this bias. This research contributes to academic knowledge by showing that a benefit of stop losses is to help investors that are prone to bias make less bias decisions. An automatic trading strategy which is similar to stop losses strategies is the use of limit orders. Research has found that sell limit orders can increase the observation of the disposition effect because when an investor uses them they are always selling stocks after an increase in price (Linnainmaa, 2010). This thesis shows that a different automatic trading

strategy can decrease the disposition effect. Future research into automatic trading strategies and decision making bias needs to consider both limit orders and stop losses.

A relationship worth considering is the relationship between sophistication and experience. In Chapter 2 it was argued that the two concepts should be considered separately because an increase in experience does not necessitate a corresponding increase in technical knowledge. In other words, investors can gain experience without learning. Thus, I chose to measure the two concepts separately and let sophistication focus on technical knowledge and experience focus on other aspects of learning. However, it could be argued that the two concepts are related if the definition of knowledge is expanded. Other forms of knowledge, such as knowledge gained through the experience of holding a losing investment, may be relevant to reducing susceptibility to the disposition effect. This point returns to a gap in the literature, which is that research on susceptibility to the disposition effect has not shown what experienced and sophisticated investors do differently in order to be less susceptible to this bias. This thesis is the first research to address this gap through the application of psychological theories to real world data on decision making bias. In doing so it contributes to literature on decision making bias in several ways.

Firstly, the thesis shows that system 1 cognition is related to decision making bias in a real world setting. This findings supports models of decision making bias based on dual process theory (Kahneman, 2003). Other research has shown that heuristics

can be used for optimal decision making outside of the laboratory (Gigerenzer, 2004, Gigerenzer et al., 1999) and that professional decision makers use an intuitive approach to their decisions (Klein, 1999, Phillips et al., 2004). This research focused on a real world bias made by non-professional investors and contributes to knowledge by showing a relationship between the bias and system 1 based cognition. After closer scrutiny, it was found that self-rated intuitive ability had an influence on the disposition effect but self-rated intuitive preference did not. An interpretation of this result is that investors' self belief in intuition increases the disposition effect. Similarly, Fenton O'Creevy et al (2011b) found that high performing traders use intuition, but engage with it critically. The traders looked for reasons to support or reject intuitive hunches when making decisions. My findings suggest that a strong faith in intuitive ability is misplaced and that a critical evaluation of intuition is required to de-bias decision making.

Secondly, the finding that system 1 increases susceptibility to the disposition effect also contributes to what we know about the relationship between experience and the disposition effect. This thesis found that system 1 cognition is negatively correlated with age ($r = -0.28$, $p < 0.01$, $N = 261$). When age and system 1 cognition were included in the same analysis, the influence of one variable remained constant but the other variable became insignificant. Specifically, when age is considered, the influence of system 1 on the probability of losses became insignificant. When system 1 is considered, the influence of age on the probability of holding gains became insignificant. Thus, it appears that there is a kind of reciprocal relationship between age, system 1 cognition and the disposition effect. A possible

interpretation of these findings is that older investors are learning not to use intuition when making investment decisions and this in turn decreases their susceptibility to the disposition effect. A different interpretation is that there is no relationship between intuition and the disposition effect. The significant results for the experiential scale occur because it is negatively related to age and age has a large influence on the disposition effect. It is not possible to determine the exact relationship between these variables in this data but future research could investigate the relationship between these three concepts.

In this thesis I argued that system 2 cognitive processes are related to less susceptibility to the disposition effect. Initially no support was found for this hypothesis. However, analysis of rational subscales showed that they had an antagonistic influence on trading gains. The findings indicated that having a preference towards system 2 cognition increases the probability of holding gains; however, having confidence in one's ability to use system 2 cognition decreases the probability of holding gains. Accompanying these results it was found that the distribution of answers to the rational ability subscale were negatively skewed, with most investors rating themselves as having a high rational ability. Pacini and Epstein (1999) report the means for the long version of the REI as 3.39, 3.34 and 3.44 for the rational scale, rational ability subscale and rational preference subscale, respectively. The means in this study were 3.88, 4.06 and 3.71 for the rational scale, rational ability subscale and rational preference subscale, respectively. It would seem that there is desirability bias influencing the investor's answers to this scale. This could also be creating the contradictory result for the trading gains aspect of the

disposition effect. This thesis offers caution about the use of the rational ability subscale with investors. Future research may want to control for possible social desirability or only use the rational preference scale.

A further contribution of this thesis is that it shows tentative support for the theory that system 2 cognitive processes can reduce decision making bias. There are two results which support this. Firstly, a relationship was found between higher levels of self-reported system 2 cognition and a decrease in the probability of holding losses when age, stop loss use and self rated expertise were controlled for. Secondly, those investors who scored higher on the rational preference subscale exhibited the disposition effect to a lesser extent. This thesis is unique in that it uses real world data of decision making bias to test the dual process theory model proposed by Kahneman (2003) and Kahneman and Frederick (2002, 2005). Previous support for this theory was based on experimental research (Kogler and Kühberger, 2007, Pacini and Epstein, 1999, Stanovich and West, 1998) and specifically on framing and reflection effects (Bjorklund and Backstrom, 2008, Simon et al., 2004, Smith and Levin, 1996, LeBoeuf and Shafir, 2003, Levin et al., 2002, Levin et al., 1998, Shiloh et al., 2002). This finding extends the relevance of dual process beyond experimental research as it finds tentative support that system 2 cognition decreases susceptibility to a decision making bias in a real world setting.

The final contribution made by this thesis is that reappraisal emotion regulation reduces decision making bias in a real world setting. Previous research which investigated the influence of emotions on investment decision making performance

found contradictory results (Lo et al., 2005, Seo and Barrett, 2007). This thesis suggested that emotion regulation may be a plausible method of understanding these contradictory results. The results very tentatively suggest that there is a link between emotion regulation and reduced decision making bias but this link should be endorsed with caution. As this relationship is not robust, it suggests that there may be other factors involved in moderating emotion regulation's influence on financial decision making bias. Whilst, theories of decision making show that emotion influences risk based preferences (Bechara and Damasio, 2005, Loewenstein and Lerner, 2003) and that emotion regulation can lead to more optimal decision making (Sokol-Hessner et al., 2009, van't Wout et al., 2010, Wallace et al., 2009), this thesis suggests that more specific detail is needed to make these assertions for the disposition effect. For example, it remains unclear what emotions are being regulated and to what purpose they are being regulated (Koole, 2009). Investors maybe regulating emotions to make themselves feel better about losing money rather than to learn to improve decision making performance. Future research may need to address issues such as these, before investigating the link between emotion regulation and the disposition effect.

9.2 Limitations and future research

The purpose of this section is to discuss the limitations of this research. It begins by discussing the limitations with measuring the disposition effect, then the demographic variables, followed by the psychological variables and finally, the generalisability of the results. As each limitation is outlined, ways in which future research could overcome these limitations are presented.

9.2.1 Measuring the disposition effect

This thesis used survival analysis to measure the disposition effect (Feng and Seasholes, 2005) because this is the best suited methodology for the data collected. However, a limitation is that Odean's (1998) method was not adopted to calculate the disposition effect. Two advantages of Odean's (1998) method are that it calculates the disposition effect using all of the investment data and a measurement of the disposition effect can be made for each investor. With the methodology I adopted, only roundtrip data was used for analysis and the disposition effect was calculated at the transaction level, rather than the investor level. The reason for this choice was partly due to portfolio data not being available. Future research could obtain portfolio data and adopt both methods to overcome this limitation.

Another limitation is that I did not control for the influence that market movements and tax loss selling could have on the disposition effect. During the observation period from 2006 - 2009 there was a significant financial crisis that contributed to a stock market crash, followed by a significant recovery. There is some evidence that a bear and bull market could influence the size of the disposition effect (Leal et al., 2010). Also, previous research has found that tax loss selling can reduce the disposition effect in the month prior to the tax year end (Odean, 1998). I was advised by the discount brokerage firm that tax loss selling was not prevalent amongst its clients because the tax free allowance on capital gains was high enough so that the majority of investors do not pay capital gains tax. The tax free allowance for the capital gains tax was £8,800, £9,200 and £9,600 for the 2007, 2008 and 2009

tax years, respectively (HMRC, 2012). Nonetheless, this thesis has not controlled for the influence of the market condition and tax loss selling on the disposition effect. These considerations could be included in future research.

9.2.2 Demographic variables

A limitation which can be applied to all of the demographic variables is the extent to which their use can further the understanding of susceptibility to the disposition effect. Whilst relationships can be identified in the data, demographic proxies are used to measure other variables. The validity of this relationship is not tested and needs to be asserted by the researcher. For example, this thesis found a strong relationship between age and the disposition effect and I argue that age is a proxy for experience. However, as mentioned earlier, there could be other reasons why older investors are less prone to this bias. To overcome this, future research could adopt a qualitative methodology enables an in-depth understanding. For example, trading data could be used to identify groups of investors based on their susceptibility to the disposition effect and then qualitative interviews could be used to gain an in-depth understanding of how these groups make investment decisions.

Another limitation associated with the demographic variables pertains to the measurement of the number of cumulative trades. This variable was estimated using current trading frequency and the years of investment experience. Other research on the disposition effect has used data sets which include only investors new to investing. This research has measured cumulative trading frequency by

counting the number of trades the new investors make (Feng and Seasholes, 2005, Seru et al., 2010). Their method is a more accurate measure of cumulative trades when compared to the method adopted by this thesis. Future research which investigates the influence of experience on the disposition effect could focus solely on new investors.

9.2.3 Psychological variables

A limitation associated with the psychological variables is that they were measured using self-report data. This can be problematic because the validity relies on the accuracy of this self-report. It is possible that investors may not accurately report the method of emotion regulation and cognitive style which applies to their investment decisions. This problem is highlighted by the skewed distribution on the rational ability scale, which showed that more investors rated themselves as having high rational ability than would be expected in a normally distributed set of respondents. Future research may overcome this problem by using measures which are not self report. For example, Fenton O'Creevy et al (2011a) measured the emotion regulation amongst traders by measuring changes in their heart rate.

A further limitation associated with the psychological variables is that the methodology is retrospective. By retrospective it is meant that when viewed chronologically, the disposition effect was measured using data collected before the independent variables. This limitation is of concern for two reasons. Firstly, the investor's score on the psychological variables could change over time. Thus, the

measurement of these variables may not relate to investment decision making which occurred up to 3 years prior. In response to this critique, the REI and emotion regulation questionnaire do measure trait based personality variables, and the emotion regulation questionnaire has showed reliability over time (John and Gross, 2004). The second concern relates to causation as this can never be assessed when a cross sectional research design is used. Thus, it is possible that the disposition effect and psychological variables show a relationship because of a common relationship with an unmeasured variable. Future research could use an experimental design where the independent variables are manipulated before trading to show causation. Another approach is to measure dual process theory and emotion regulation prior to obtaining trading data.

9.2.4 Generalisability

A limitation which only pertains to the questionnaire data is its generalisability. Whilst significant results were found with the 261 responses, there were some variables which became insignificant when more complex models were created. For example the relationship between the disposition effect and reappraisal was significant only at the 90% level when other variables were included in the regression. Also, there was a slightly larger amount of disposition effect exhibited by the investors included in questionnaire analysis than those investors not included in the analysis. Finally, the number of investors who responded to the questionnaire and could be classified as sophisticated (N=7) was too small to use this as a control variable. Future research could overcome these limitations by collecting more responses to the questionnaire data, choosing to sample investors by the amount of

disposition effect they exhibit and adopt a sampling strategy that includes more sophisticated investors.

Another limitation is to whom the findings of this thesis can be generalised. The focus of research on the disposition effect has been individual investors in stock markets (Odean, 1998, Shefrin and Statman, 1985). Therefore, this thesis generalises results to individual investors in the UK. However, a key assumption of the disposition effect is that the investors are selling their stocks. Therefore, the results cannot be generalised to investors who adopt a buy and hold strategy towards investments. Also, as mentioned in Chapter 2, the disposition effect has also been observed in professional traders (Locke and Mann, 2005) and day traders (Jordan and Diltz, 2004). These traders have shorter roundtrip trade duration, are investing in more complex markets and make decisions more frequently. The findings of this thesis cannot be generalised to traders but future research could investigate whether the results found here apply to traders also.

9.3 Implications for policy and practice

This section outlines the implications of the findings of this thesis for policy and practice. The findings of this thesis have implications for investors, brokerage firms, UK policy makers and decision makers in general. Implications for each of these groups are outlined below.

Previous research has found that the disposition effect is associated with poor trading performance (Odean, 1998, Seru et al., 2010). Therefore, the disposition effect is of relevance to investors who wish to improve their portfolio returns. This thesis has shown that UK investors with low experience, who are younger and with less knowledge are more prone to this bias. This research found that the first years of trading experience are most important to changing susceptibility to this bias. It also found that, through the use of stop losses, a new investor can significantly inoculate against this bias. An implication of this is that new investors may want to use stop loss strategies at the beginning of their investing career. The research also suggests that these investors should be critical of their ability to make intuitive decisions and should have a preference towards using rational decision making processes.

The disposition effect also has relevance for brokerage firms who want to retain customers. Research has found that often investors lose money and cease trading (Seru et al., 2010). This is a loss of revenue for brokerage firms so they should have a vested interest in helping new investors overcome this bias. My research implies that if brokerage firms want to help investors overcome this bias, they should target younger investors and those investors with less years of investment experience because these investors are the most prone to the disposition effect. The methodology of calculating the disposition effect could also be adapted so that brokerage firms could give individual investors personalised information on their susceptibility to this bias. Furthermore, an implication of this research is that they

should consider educating investors further on the benefit of stop loss strategies and why they should be adopted.

These findings also have relevance for UK policy makers. Since liberalisation of the financial services industry there has been a push of responsibility on the individual for their future financial security. Also the UK government encourages direct investment in the stock market through tax breaks for Self-Invested Personal Pensions (SIPP) and Individual Savings Accounts (ISA). This research shows that some UK investors make biased decisions and other research has shown that this bias is associated with poorer investment performance (Odean, 1998, Seru et al., 2010). An implication of this thesis is that it questions whether the endeavours by UK policy makers to encourage investment in the stock are beneficial for the individual investors. At the least, the findings of this thesis suggest that the incentives to encourage stock market investment should be accompanied with information about the potential problems an investor faces when investing in the stock market.

Another implication of this research concerns decision makers in general as it uncovers the role that intuition plays in decision making bias. The findings imply that decision makers should be wary of intuitive judgements as they can lead to biased decision making. This may have implications for contexts outside of stock market investment, such as personal finance and organisational contexts. Furthermore, the finding that system 1 cognitive ability had a positive association with decision making bias implies that a strong faith in intuition may be misplaced. Decision makers may

need to engage critically with their intuitions and seek out evidence to confirm or disconfirm intuitive hunches rather than place blind faith in them.

9.4 Conclusion

Investors experience a reluctance to sell investments at a loss, yet an eagerness to sell them at a gain. We now understand this deviation from normative rational investor behaviour is detrimental for an investor because it is associated with poorer investment performance (Odean, 1998, Seru et al., 2010). However, there are gaps in our understanding of what is causing bias in decision making. In relation to the disposition effect, explanations based on prospect theory have been found to be incomplete (Kaustia, 2010, Summers and Duxbury, 2012). The thesis identified a relationship between intuition and the disposition effect suggesting that automatic, affect driven decision making, by non-professional investors, can lead to increased decision making bias. In particular, it shows that a strong belief in one's intuitive ability is associated with more susceptibility to decision making bias.

One focus of research on decision making is how to overcome bias in decision making. Research on the disposition effect suggests that knowledge and experience should reduce an individual's susceptibility to bias. This thesis shows that whilst these explanations have some merit, they by no means explain all of the susceptibility to this bias. Also, these arguments are vague as it is unclear what knowledgeable and experienced investors have learnt to overcome the disposition effect. The findings of this thesis indicate that the application of simple stop loss

strategies can be just as effective as knowledge in reducing susceptibility to this bias. It also suggests that investors who are less susceptible to this bias have a preference towards analytical and reason-based cognition. Implying that a reason based approach to decision making may reduce bias for non-expert decision makers. There is also tentative support that the effective regulation of emotion is of relevance to overcoming decision making bias. Future research on how to overcome decision making bias needs to look beyond knowledge and experience explanations, in order to gain a deeper understanding of decision making bias in applied contexts.

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Appendix 1: Literature review of the disposition effect

This table shows the author(s), year of publication, method and their major findings of research related to the disposition effect. The table distinguishes between three different methodologies for disposition effect research; an experimental methodology which uses trading based exercises to measure the disposition effect; individual which analyses investors' or traders' buying and holding patterns and aggregate which correlates stock market wide data with volume turnover. This overview only reviews literature which has empirical evidence of the disposition effect where theoretical articles (for example Barberis et al., 2001) and articles which don't measure the disposition effect (for example Fogel and Berry, 2006) have been excluded. It also focuses on the disposition effect in financial markets so research from other domains such as housing sales (for example Genesove and Mayer, 2001) have also been excluded.

Author	Unit of analysis	Methodology	Major finding
(Barber et al., 2007)	Taiwan Stock Exchange 1995- 1999	Individual	Finds the disposition effect is exhibited by Taiwanese individuals, corporations, dealers but not for mutual funds or foreigners. Gender did not influence the disposition effect. Strong market returns increases the willingness to sell losers.
(Boolell- Gunesh et al., 2009)	French discount brokerage house 1999 to 2006	Individual	French investors are susceptible to the disposition effect. Sophistication reduces the disposition effect.
(Bremer and Kato, 1996)	Tokyo Stock Exchange 1975 1990	Aggregate	Finds that there is more volume for winner stocks than for loser stocks. This is in excess even in March the tax year end month.

(Brown et al., 2006)	Australian share registry for IPOs 1995-2000	Individual	Finds the disposition effect occurs in Australia but that it disappears over time—generally after 200 days of holding an IPO. Also finds that insurance companies, trusts and nominees and investors with larger trades have less disposition effect. Tax loss selling in June is shown to reverse the disposition effect.
(Brown and Kagel, 2009)	Ohio University Students	Experimental	Finds the disposition effect does not exist when participants can only hold one stock at a time and when they must reinvest in another stock instead of selling.
(Chen et al., 2007)	individual investors and institutional traders in China from May 1998 to Sept 2002	Individual	Institutional and individual investors suffer from the disposition effect but individuals more than institutional. Cosmopolitan and middle aged investors have stronger disposition effect but the disposition effect decreases with trading frequency and investors with larger accounts.
(Chui, 2001)	Macau students	Experimental	Correlated the data with the locus of control and found an external locus of control decreases the disposition effect.
(Coval and Shumway, 2005)	CBOT T-Bond future traders 1998	Individual	Professional traders assume significantly more risk in the afternoon following losses in the morning.
(Da Costa et al., 2008)	Brazilian students	Experimental	When previous periods price is used as a reference point, women are less susceptible to the disposition effect.
(Dhar and Zhu, 2006)	Discount Brokerage house 1991 - 1996	Individual	Wealthier individuals and individuals employed in professional occupations exhibit less disposition effect. Also as trading frequency increases the disposition effect decreases.
(Feng & Seasholes, 2005)	1511 Chinese Investor's brokerage accounts Jan 1999-Dec 2000	Individual	Investor sophistication and experience eliminate the reluctance to realise losses and reduce realising gains.
(Ferris et al., 1988)	30 smallest stocks on the CRSP Dec 1981-Jan 1985	Aggregate	A correlation between historical price increases (decreases) and more (less) volume traded.
(Frazzini, 2006)	NYSE trades and Quotation 1993-2002 , CRSP/COMPUSTAT 1980 - 2002, Brokers Estimates 1993 -2002	Aggregate	When most of the stockholders of a company are facing a capital loss, negative news generates a negative post-announcement drift. For stocks with capital gains, positive news creates a positive post announcement drift.

(Frino et al., 2004)	Sydney future exchange traders 15th March 1999 to 30th June 1999	Individual	A stronger disposition effect occurred amongst local traders than non local.
(Garvey and Murphy, 2004)	15 NASDAQ Proprietary traders	Individual	The disposition effect occurs for proprietary traders and this affected potential profitability.
(Garvey et al., 2007)	150 NASDAQ proprietary traders June 2002 - May 2003	Individual	Traders who experienced a loss in the morning take riskier trades in the afternoon to recoup losses.
(Goetzmann and Massa, 2008)	Discount brokerage database 1991 to 1996	Individual	That the disposition effect could influence stock volatility, stock return, and trading volume.
(Grinblatt and Han, 2005)	NYSE and AMEX common stocks 1962- 1996	Aggregate	That the disposition effect can explain momentum in the stock market
(Grinblatt and Keloharju, 2001)	Finnish central register of shareholdings	Individual	Investors engage in tax loss selling activity and that household and non-financial corporations are more likely to trade with the disposition effect.
(Haigh and List, 2005)	USA students/ CBOT professional traders	Experimental	More frequent feedback makes participants more risk averse in line with Myopic Loss Aversion. Also finds that traders are more Myopic Loss Averse than students.
(Huddart et al., 2009)	NYSE, AMEX, NASDAQ 1982 - 2002	Aggregate	Volume of stock is significantly higher when it reaches and exceeds a previous 52 week high.
(Hyuk and Yunsung, 2009)	Korea futures market	Individual	Shows that the disposition effect occurs in the stock futures market and that it is reduced by sophistication and experience. It also shows a relationship between the disposition effect and poor investment performance.
(Jordan and Diltz, 2004)	Day traders accounts from Feb 1998 to October 1999	Individual	65% of day traders exhibit the disposition effect. However, in a short sale sub-sample no disposition effect was found.
(Kaustia, 2004)	USA IPOs 1980 - 1996	Aggregate	When IPOs increase above the offer price for the first time, the volume traded increases and IPOs which are negative in initial return have less volume traded. Contrarily, he found that volume was very high when the IPO first falls below the offer price which is inconsistent with the disposition effect.

(Kaustia, 2010)	Finnish Central Security Depository 1994 - 2000	Individual	Shows that the pattern of selling stocks does not follow a prospect theory based explanation of the disposition effect.
(Kirchler et al., 2005)	Austrian students	Experimental	Framing of dividend based information influences the disposition effect. When presented with dividend information in a "more than" percentage probability as opposed to a "less than" percentage probability participants held both losing and winning stocks longer. This mediated the disposition effect.
(Kumar and Lim, 2008)	US discount brokerage firm 1991-1996	Individual	Finds that investors who execute more clustered trades exhibit weaker disposition effects.
(Lakonishok and Smidt, 1986)	NYSE/ ASE 1971-82	Aggregate	Winners tend to have an abnormally higher volume traded than losers. The opposite occurs in December for tax loss selling.
(Leal et al., 2010)	Portuguese discount brokerage firm 1999 - 2002	Individual	Finds evidence of the disposition effect in Portugal. Finds more of the disposition effect in a bull market than a bear market.
(Lee et al., 2008)	Online virtual market/ Korean students	Individual/ Experimental	Prospect theory not belief in reversion to the mean causes the disposition effect. Also completing mathematical tasks before trading eliminates the disposition effect. The bear or bull market has no influence on the disposition effect.
(Lehenkari and Perttunen, 2004)	Finnish Central Security Depository Jan 1995- Sept 2000	Aggregate	Capital gains do not make investors sell shares but capital losses do make investors not sell shares. This means investors are loss averse but not in direct support of the disposition effect.
(Lehenkari, 2012)	Finnish Central Security Depository	Individual	Finds that investors who inherit stocks exhibit less disposition effect than investors who purchase stocks.
(Linnainmaa, 2010)	Finish Central Securities Depository 1995 - 2002	Individual	Finds evidence of the disposition effect in Finland and that investor's use of limit orders increase the occurrence of the disposition effect.
(Locke and Mann, 2005)	Commodity future traders 1995	Individual	Unprofitable trades are held longer than profitable ones. Also finds that traders who offset losses more quickly are more likely to be successful in the future.
(Locke and Onayev, 2005)	Commodity future traders 1995	Individual	Unprofitable trades are held longer than profitable ones.

(Odean, 1998)	Discount Brokerage house 1987 - 1993	Individual	That the disposition effect occurs in every month except December due to tax loss selling. The disposition effect is associated with poorer investment performance.
(Oehler et al., 2003)	German students	Experimental	The disposition effect occurs when purchase price and last period's price were used as a reference point. The disposition effect was less when students used last period's price because they were forced to sell shares at the end of each trading period.
(Rangelova, 2001)	investors accounts	econometrics	Finds that the disposition effect occurs only for large market capitalized stocks and not small stocks.
(Rubaltelli et al., 2005)	Italian students	Experimental	Framing of information on gains or losses as percentages instead of dollar amounts reduced the disposition effect.
(Seru et al., 2010)	Finnish central register of shareholdings 1995 to 2003	Individual	The disposition effect declines with experience when experience is measured as amount of trades rather than years. This learning occurs very slowly.
(Shafran et al., 2009)	Israeli students	Experimental	The disposition effect only occurred when participants were given market based return information.
(Shapira and Venezia, 2001)	Israeli investors brokerage account 1994	Individual	Finds that both professional and independent investors exhibit the disposition effect but professionally assisted investors less so.
(Shu et al., 2005)	Taiwanese security brokerage house from Jan 1998 to Sept 2001	Individual	Finds that female and elderly investors are more likely to exhibit the disposition effect in Taiwan.
(Shumway and Wu, 2006)	Chinese Individual Investors and firms 2001-2004	Individual	Individual investors exhibit more disposition effect than firms. Also investors who exhibit the disposition effect trade less frequently and in smaller sizes.
(Statman et al., 2006)	NYSE and AMEX common stocks 1962- 2002	Aggregate	When there were high security returns there was a lagged high turnover.
(Summers and Duxbury, 2012)	UK students	Experimental	Disposition effect only occurs when students experienced regret and not disappointment.
(Szyszka and Zielonka, 2007)	Warsaw stock market IPOs	Aggregate	Volume for IPOs is higher when the initial rate of return is positive and lower when it is negative.
(Talpsepp, 2010)	Estonian NASDAQ MOX Tallinn	Individual	Evidence of the disposition effect in Estonia and that the disposition effect is related to

			poor trading performance.
(Visaltanachoti et al., 2007)	SZSE & SHSE A and B shares 1996 - 2003	Aggregate	The disposition effect occurred in the Chinese stock market.
(Weber and Camerer, 1998)	German students	Experimental	Finds evidence of the disposition effect the when purchase price and last period's price were used as a reference point. Disposition effect was less when students used last period's price because they were forced to sell shares at the end of each trading period.
(Weber and Welfens, 2008)	Online German investor accounts 1997 - 2001 / German students	Experimental and individual	64.5% of individual investors exhibit the disposition effect and 34.5% of investors do not. Investors who exhibit a strong tendency to sell winners are not the same investors who stick to their losers. That the disposition effect in individuals is consistent over time but they also learn to slightly change this behaviour. The disposition effect is reduced through high trading volume.
(Wong et al., 2006)	USA Students	Experimental	Disposition effect occurs in an experimental setting. No personal characteristics like, age, gender, married and children are associated with It. Found that it is more likely to occur in periods of high uncertainty.

Appendix 2: Examples the of Appropriateness Assessment questions

- Are you fully aware of the risks these types of investments carry?
- Would you be prepared to lose a significant part of your investment?
- How long have you been dealing in the stock market?
- What is your average total *dealing* activity per year?
- What is the approximate value of your overall investment portfolio?
- Do you believe your educational background and/or profession or former profession are relevant in understanding the risks involved?
- What level of your overall portfolio does this investment represent?

Appendix 3: Questionnaire items

The emotion regulation questionnaire

Reappraisal items

1. I control my emotions by changing the way I think about the situation I'm in.
2. When I want to feel less negative emotion, I change the way I'm thinking about the situation.
3. When I want to feel more positive emotion, I change the way I'm thinking about the situation.
4. When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.
5. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.
6. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.

Suppression items

7. I control my emotions by not expressing them.
8. When I am feeling negative emotions, I make sure not to express them.
9. I keep my emotions to myself.
10. When I am feeling positive emotions, I am careful not to express them.

The questions are answered on 7 point Likert scale

The Rational Experiential Inventory

Rational scale = Rational ability + rational preference

Rational ability

1. I have a logical mind.
2. I am not a very analytical thinker-r
3. I am much better at figuring things out logically than most people.
4. I am not very good at solving problems that require careful logical analysis. -r
5. Using logic usually works well for me in figuring out problems in my life.
6. Reasoning things out carefully is not one of my strong points.

Rational preference

7. Knowing the answer without having to understand the reasoning behind it is good enough for me. -r
8. I prefer complex to simple problems.
9. I enjoy problems that require hard thinking.
10. I don't like to have to do a lot of thinking. -r
11. I enjoy intellectual challenges.
12. I try to avoid situations that require thinking in depth about something. -r

Experiential scale= Experiential ability + experiential favourability

Experiential ability

13. When it comes to trusting people, I can usually rely on my gut feelings.
14. I suspect my hunches are often inaccurate. -r
15. I trust my initial feelings about people.
16. If I were to rely on my "gut feelings," I would often make mistakes.
17. I believe in trusting my hunches.
18. I don't have a very good sense of intuition.

Experiential preference

19. I don't think it is a good idea to rely on one's intuition for important decisions.-r
20. I often go by my instincts when deciding on a course of action.
21. I generally don't depend on my feelings to help me make decisions.- r
22. I like to rely on my intuitive impressions.
23. I don't like situations in which I have to rely on intuition.-r
24. I think there are times when one should rely on one's intuition.

These questions are measured on 5 point Likert scale.

Investor experience

For how many years have you been actively investing in the stock market?

Please enter the amount of years as a number

Self rated expertise questions

To what extent does your work experience (current and previous occupations) make you skilled at stock market investment?

To what extent does your official education (secondary school, tertiary education, etc) make you skilled at stock market investment?

To what extent does your informal learning make you skilled at stock market investment?

These questions were measured on a four point Likert scale ranging from 1 *not at all* to 4 *a great deal*.

Appendix 4: Information contained within the trading data

Contact Type: How the investors contacted the brokerage firm to place the trade E.g.

telephone, internet

Market dealt date/time: The date and time the trade occurred

Gross purchase/ Gross sale: the amount the investor paid to buy or sell the stocks excluding

brokerage fees and stamp duty tax

Commission: The amount of brokerage fees charged for the trade

Net value: Gross purchase or sale + commission + tax

Investment number: a unique number used to identify the investment

EPIC code: The EPIC code for the stock

ISIN: The ISIN number for each stock

Investor Number: A number generated for each stock

Sex: The gender of the account holder

Age: The account holders age as at 15/12/2009

Account type: The type of account e.g. normal or ISA

Stop loss: Whether a sale was triggered by a stop loss

Appendix 5: Filtering trading data into roundtrip transactions, calculating the share weighted average purchase price and controlling for corporate actions

Roundtrip formation

Filtering the data so that only roundtrip transactions remained began with removing irrelevant data. Data was removed for the following reasons:

1. Trades were removed if an investor sold a stock without a prior purchase in the data
2. Investors were removed if they had never completed a sale trade during the observation period
3. Investors were removed if they had incomplete demographic information (gender and age)
4. Investors were removed if they were 18 years old or younger (at the request of the brokerage firm)

After this data was removed 5,085 investors, who made 318,504 trades, were left.

The next step in organising the data into roundtrip transactions was to create an investor stock holding balance. The data was sorted by investor number, investment name, account genre, market dealt date and market dealt time. The term account genre refers to the three groups of account types offered by the discount brokerage firm. The first account genre is all the standard trading accounts where an investor buys and sells investments. The second account genre is all the Individual Savings Accounts (ISA) and the third genre is all Self Invested Pension Plan (SIPP) accounts. Every account type was classified into one of these three genres because shares purchased by one account genre are very rarely transferred to

another. Thus, by using the account genres, roundtrips could be more accurately identified in the trading data. When the data was sorted by the five items mentioned above, an investor stock holding balance was created by comparing one row of data (one trade) to the row above it. If a trade was made by a different investor, or in a different investment name or not within the same account genre, then the investor stock holding balance would be equal to that trade. But if a trade was made by the same investor, in the same investment name and within the same account genre, the investor stock holding balance would be added to the previous trade's investor stock holding balance. Thus, the investor stock holding balance represents the amount of units an investor holds in a stock after the completion of each trade.

In addition to the investor stock holding balance column, a unique transaction number was created to identify roundtrip transactions. The unique transaction number clustered the trades together if the trades were made by the same investor, in the same stock and within the same account genre. In order to identify roundtrip transactions the unique transaction number updated after the investor stock holding balance was equal to zero, with a sell trade. This allows the distinction between transactions which end at zero (roundtrip transactions) and those that do not (buy and hold transactions and buy and sell transactions). In the sample data of 318,504 trades, there were 168,290 trades which could be classified into 64,804 roundtrip transactions. There were 150,214 trades which could not be clustered into roundtrip transactions and these are referred to as non-roundtrip trades. Of these non-roundtrip trades, 90,304 of them occurred because an investor bought but never sold the stock during the observation period. These were removed from the trading data which left 59,910 non-roundtrip trades.

Calculating the share weighted average purchase price

The method of calculating the disposition effect involves comparing the reference point (assumed to be the purchase price) to the market price on a daily basis for each roundtrip. As the investor can make several trades within one roundtrip it is important that this purchase price updates when secondary purchases occur within a roundtrip. In relation to investors selling off in multiple trades, this thesis only analyses the roundtrip transaction until the first sell transaction (Feng and Seasholes, 2005). The rationale for this is that the disposition effect aims to measure the influence of gains or losses on the decision to first realise a stock. This means that the multiple sale trades with a roundtrip transaction do not influence the disposition effect calculations. However, there is a need to have a purchase price which updates when additional purchases are made.

I adopted a share weighted average purchase price (SWAPP) and this is calculated by developing a cumulative value invested for each roundtrip. The cumulative value invested represents the value in GBP that the investor has purchased in the stock, at the completion of each trade, within the roundtrip. This value excludes transactions costs and dividends because I assume that the execution price of the stock more accurately measures the reference point than with the inclusion of transaction costs. Research has found that the inclusion or exclusion of transaction costs and dividends did not significantly alter the level of the disposition effect (Odean, 1998). SWAPP is calculated with this formula:

$$SWAPP = \frac{\text{cumulative value invested}}{\text{investor stock holding balance}} \quad (9)$$

SWAPP updates when additional purchases are made because the cumulative value invested and investor stock holding updates at the completion of each purchase trade. When a sell trade occurs, the SWAPP assumes the value from the previous trade within the roundtrip. Thus, SWAPP is compared with the stock price data on the day of sale to calculate whether a stock is trading at a gain or loss. However, corporate actions such as splits, consolidations, rights issues and scrip dividends could influence the investor stock holding balance and cumulative value invested. The method of controlling for these is outlined in the next subsection.

Controlling for corporate actions

In this section I outline the types of corporate actions controlled for in this data and then explain how the data was adjusted for these corporate actions. Some corporate actions were easily controlled for in the data. These corporate actions are stock splits, consolidations and scrip dividends. A stock split is where a company increases its number of shares, a consolidation is where a company decreases its number of shares, and a script dividend is where a company issues extra shares as a form of dividend. In these situations, the investors do not normally have a choice about the change to their share holding, so I can apply a formula to correct their holding or purchase price (these formulas are outlined below). However, controlling for corporate actions where a company attempts to raise funds privately from their shareholders investors, posed a unique obstacle for this thesis. Barnes and Walker (2006) find that in other stock markets, such as those in the USA, attempts to raise additional funds by companies are open to the public. The UK stock markets are unique, in that the focus is on private placements with existing shareholders.

The two types of corporate actions most commonly used by UK firms are open offers and rights issues (Barnes and Walker, 2006).

An open offer is an invitation to existing holders of securities to subscribe or purchase securities in proportion to their holdings (Barnes and Walker, 2006). Furthermore, open offers often enable investors to purchase additional shares over and above their entitlement (an excess application). From an investor's perspective, they have the opportunity to purchase additional shares in a company or they can ignore this offer and let it lapse. If the investor let the open offer lapse they would not receive any compensation. In relation to the trading data collected in this thesis, it is very difficult to ascertain if an investor took up the open offer or not because portfolio data was not available. Also, if an assumption is made that the investors subscribed to their open offers, it is very difficult to gauge the number of additional shares that the investor would have purchased. They could have partially, fully or excessively subscribed to their entitlement. For these reasons, open offers were not controlled for in this data.

A rights issue is an offer to existing holders of securities to subscribe or purchase further securities in proportion to their holdings, made by means of the issue of a renounceable letter (or other negotiable document) which may be traded (as 'nil paid' rights) for a period before payment for the securities is due (Barnes and Walker, 2006). From an investor's perspective they have three options when a rights issue is announced; exercise their right to buy more shares, sell the rights issue or let the rights issue lapse. If an investor chose to let the rights issue lapse, their rights are often sold on their behalf and they receive the proceeds from this (minus any transactions costs). With rights issues, it was possible to

gauge what investors were choosing to do. Firstly, I investigated the extent to which investors were trading their nil paid rights and found that investors rarely traded their rights. I estimated that there were 6,277 nil paid rights given to 3,109 investors but only 304 (4.84%) of these rights traded. This suggests that the majority of investors do not trade nil paid rights. Secondly, I investigated how successful the rights issues were over the observation period of the data. The most commonly held stocks that underwent a rights issue, achieved above a 90% subscription rate. Based on this information, I assumed that investors were taking up the rights issues and adjusted their holdings accordingly.

I now explain how I controlled for corporate actions in the trading data. There were two groups of trading data which needed adjusting. Firstly, there are the trades which were formed into roundtrip transactions and these were analysed to ascertain if a corporate action influenced the SWAPP. Secondly, there are the non-roundtrip trades which need to be investigated to ascertain whether a corporate action is changing the investor's holding, and stopping them from becoming a roundtrip. With the first group of trades it was found that corporate actions influenced only 533 (0.82%) roundtrip transactions. Due to the small number of these roundtrip transactions being influenced, the method of adjusting for these corporate actions was to use Datastream's adjustment factor. Datastream (2010) creates an adjustment factor so that stock prices prior to and after a corporate action can be compared. For these roundtrips transactions, the purchase price and the daily stock prices were multiplied by the adjustment factor, thereby making the values comparable over a corporate action. The adjustment factor represents the cumulative adjustment coefficients pertaining to a security which is multiplied against the unadjusted price to create the

adjusted price. Datastream (2010) stated that the adjustment factor is calculated as follows:

Stock subdivision or Stock Split

$$\text{Adjustment factor (AF)} = \frac{\text{new terms}}{\text{old terms}} \quad (10)$$

Bonus / Scrip Issue

$$\text{Adjustment factor (AF)} = \frac{\text{old terms} + \text{new terms}}{\text{old terms}} \quad (11)$$

Rights Issue/Open Offer

$$\text{Adjustment factor (AF)} = \frac{\text{cum price}}{\text{ex-price}} \quad (12)$$

$$\text{Ex price} = \frac{(\text{issue price} \times \text{new terms}) + (\text{cum price} \times \text{old terms})}{(\text{new terms} + \text{old terms})} \quad (13)$$

Where *cum price* is the unadjusted stock price before the ex date, *ex date* refers to the date at which the corporate action takes place, *new terms* is the number of shares the shareholder will receive for every share held, *old terms* is the number of shares required to be held to receive new shares and *issue price* is the price at which the new shares are issued.

The second category of transactions which require an adjustment for corporate actions is the non-roundtrip trades. With these trades it is not only the SWAPP which needs adjusted, but also the investor stock holding balance. This may be inaccurate because the corporate action has created additional shares or consolidated shares. Thus the 59,910 non-roundtrip trades were investigated to determine whether corporate actions were influencing the investor stock holding balance and preventing them from being formed into roundtrip

transactions. There were 1,479 different stocks traded within these transactions and Datastream was used to obtain information about corporate actions for each stock. There were 513 stocks which had some form of corporate action and 958 which had none. Each of the 513 corporate action reports were analysed to identify if the corporate action influenced the investor's stock holding balance. These corporate actions are rights issues, consolidations, splits or scrip issues. As mentioned above open offers were omitted from this list because it is impossible to tell whether an investor chose to partially, fully, or excessively subscribe to the open offer. All these corporate actions were compiled into a corporate action data file which detailed when the change occurred, how much the change was and how much it would cost the investor. This file consisted of 235 corporate actions across 204 different stocks. Specifically, there were 99 consolidations, 83 rights issues, 16 scrip dividends and 37 splits.

The corporate actions were integrated with the non-roundtrip trades by creating an artificial trade to represent the stock that an investor would have received from the corporate action and the investment in GBP, if it was required. The formulae used to calculate the artificial trades are as follows:

Formulae for corporate actions

Definition of terms

CQ= Number of shares held on the record date

NSR= Number of shares required

NNS= Number of new shares obtained

Round down= Round down to the nearest whole number

Consolidation

$$\text{Consolidation trade} = (\text{Round down } ((CQ/NSR) \times NNS)) - CQ \quad (14)$$

For example if an investor holds 1000 stocks and consolidation of 1 for 12 occurs.

$$= (\text{Round down } ((1000/12) \times 1)) - 1000$$

$$= (\text{Round down } ((83.333) \times 1)) - 1000$$

$$= 83 - 1000$$

$$= -917$$

Split

$$\text{Split trade} = (\text{Round down } ((CQ/NSR) \times NNS)) - CQ \quad (15)$$

For example if an investor holds 1000 stocks and a split of 2 for 1 occurs.

$$= \text{Round down } ((1000/1) \times 2) - 1000$$

$$= (\text{Round down } 2000) - 1000$$

$$= 1000$$

Scrip issues

$$\text{Rights trade} = \text{Round down } ((CQ/NSR) \times NNS) \quad (16)$$

For example if an investor holds 1000 stocks and a scrip dividend of 1 for 60 occurs.

$$= \text{Round down } ((1000/60) \times 1)$$

$$= \text{Round down } (16.67)$$

$$= 16$$

Formula for rights issues

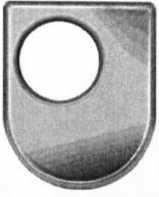
$$\text{Rights issue trade} = \text{Round down } ((CQ/NSR) \times NNS) \quad (17)$$

For example if an investor holds 1000 stocks and rights of 1 for 3.

$$\begin{aligned} \text{Rights trade} &= \text{Round down } (1000/3 \times 1) \\ &= \text{Round down } (333.33 \times 1) \\ &= 333 \end{aligned}$$

For the consolidations, scrip dividends and splits the value invested does not change but the investor stock holding does. Thus, the artificial trade reflected a change in the investor stock holding but not the cumulative value invested. When a rights issue occurs and an investor exercises all of their rights, they will have invested more money. In this situation the artificial trade updated the both value invested and the investor stock holding to reflect the change of the corporate action. 1,183 artificial trades were inserted into the non-roundtrip trading data, then the investor stock holding balance was updated to identify possible roundtrip transactions. A further 1,258 roundtrip transactions were found after treating the trading data for capital changes and these roundtrips consisted of 4,208 trades. This brought the total number of trades which could be fitted into roundtrip transactions to 172,498 consisting of 66,062 roundtrip transactions.

Appendix 6: Ethics approval



From John Oates
Chair, The Open University Human Participants and
Materials Research Ethics Committee
Research School
Email j.m.oates@open.ac.uk
Extension 52395

To Daniel Richards, Accounting and Finance Research Unit

Subject Cognitive style and emotion regulation as predictors of
the disposition effect in stock market investment.

Ref HPMEC/2009/#667/1
Date 6 January 2010

Memorandum

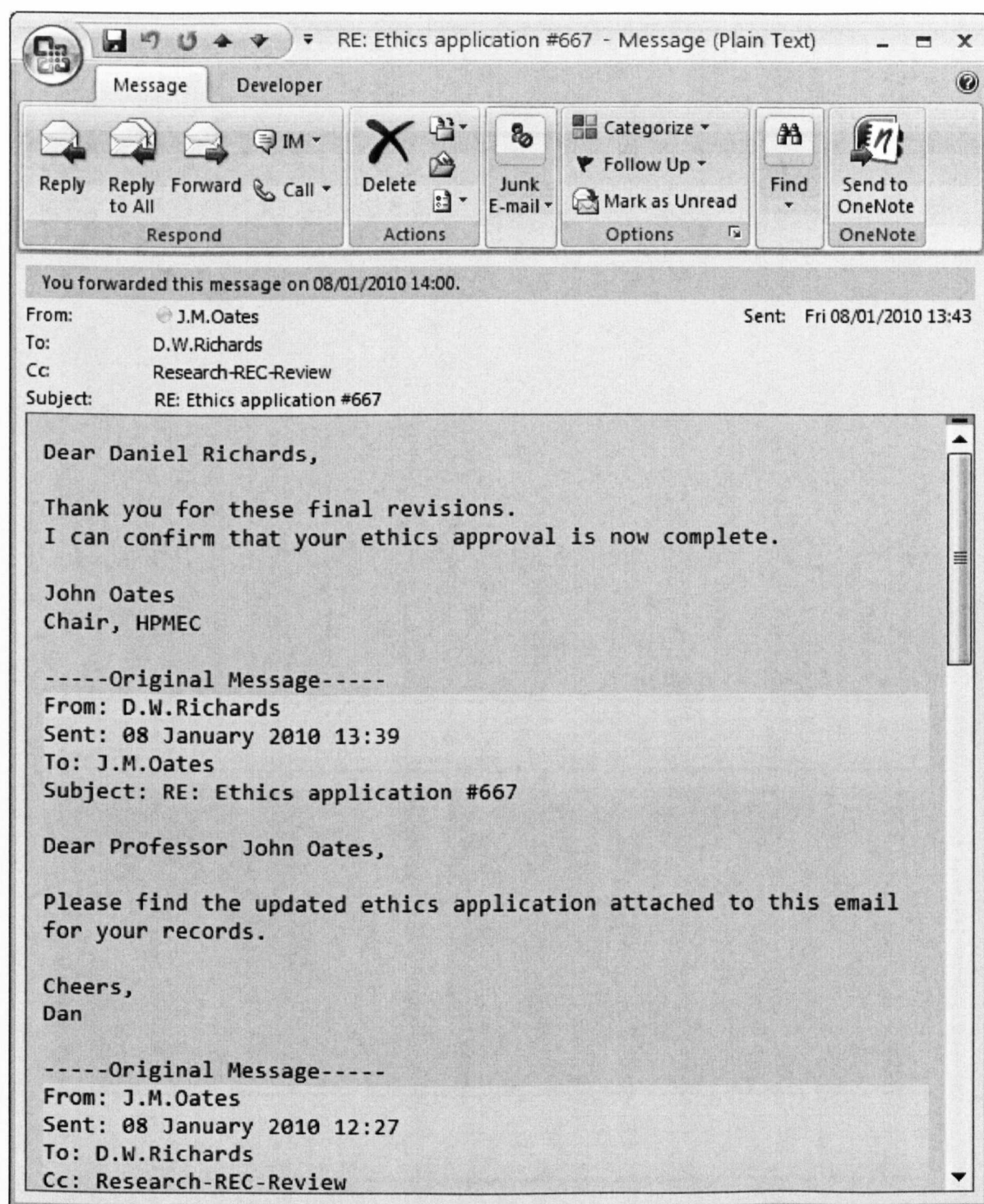
This memorandum is to confirm that the research protocol for the above-named research project, as submitted on 11th December 2009, is approved by the Open University Human Participants and Materials Ethics Committee, subject to satisfactory responses to the following:

You are asked to:

1. Clarify the nature of any access that the brokerage firm will have to your data and analyses and add this information to the invitation letter to potential participants;
2. Rephrase the sentence beginning 'I am dedicated ...' in the letter to participants so that it refers to sharing of information, rather than relationship building, to better represent the nature of the study;
3. Provide revised participant information for review.

At the conclusion of your project, by the date that you stated in your application, the Committee would like to receive a summary report on the progress of this project, any ethical issues that have arisen and how they have been dealt with.

John Oates
Chair, OU HPMEC



Appendix 7: letter of introduction



The Open
University

Business School

OU Business School

The OU Business School

Walton Hall
Milton Keynes
MK7 6AA
United Kingdom

Daniel Richards
Accounting and Finance Research Unit
Direct +44 (0)1908 654 761
d.w.richards@open.ac.uk

Dear Investor,

My name is Daniel Richards and in order to become a professional researcher in personal finance I am completing a PhD with the Open University. My area of interest is **the psychology of decision making by individual investors in the stock market**. This project investigates whether different approaches to decision making and different methods of managing emotions when investing will change the tendency to sell stocks. I am inviting you to participate in and benefit from my research.

What is involved?

In this project I will collect two types of information:

An online questionnaire You will receive an email inviting you to complete an online questionnaire. It will ask questions about your approach to decision making and how you regulate your emotions when investing. It has a brief section of only **10 questions** which will take **3 minutes**. After that, you will have the option of answering the in-depth section which has an additional 29 questions, taking 9 minutes.

Trading information: This will be supplied by the brokerage firm. This is a record of the stocks that investors have purchased and sold over the previous three years. If you agree to participate in the research by completing the questionnaire, your answers will be matched to your actual trades. I want to reassure you that this will be done confidentially and anonymously. All the information from the brokerage firm will have personal references removed and will be viewed only by people involved with this PhD.

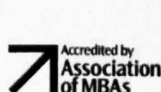
How do you benefit?

I am dedicated to communicating the results of this research project to the investors who have the opportunity to participate in it. To achieve this I have taken an innovative approach by creating a website for you. It allows you primary access to the results, contains information on research related to investment decision making and the ability to contact me if you wish. Results from this research will be posted from April 2010 onwards and information will be regularly updated. Please note that access to this website is free and not conditional on your participation in my research. Please visit www.sharemarketresearch.org

Important information

Participation in the research is voluntary. The research complies with the Data Protection Act, the Open University Ethics Principles for Research involving Human Participants and the Market Research Society's Code of Conduct. If you have any questions, please feel free to contact myself at d.w.richards@open.ac.uk. Should you wish to discuss this research with someone else, you can contact my supervisor, Prof. Janette Rutterford at j.rutterford@open.ac.uk

Yours sincerely,



The Open University is incorporated by Royal Charter (RC 000391), an exempt charity in England & Wales and a charity registered in Scotland (SC 038302)

Appendix 8: Additional analysis of questionnaire items with control variables

AP8.1 Trading loss indicator with the Rational Experiential Inventory scales and subscales when additional control variables are considered

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Questionnaire variable	Experiential	Experiential ability	Rational preference	Rational ability	Rational
TLI (Z-stat)	.4608*** (-2.70)	.5761* (-1.90)	.1675*** (-7.47)	.3829*** (-3.41)	.2267*** (-5.39)
TLI x questionnaire variable (Z-stat)	.8970* (-1.69)	.8506** (-2.53)	1.1795*** (2.95)	.9357 (-1.10)	1.0725 (1.10)
Control variables					
TLI x log estimated cumulative trades (Z-stat)	1.0711*** (2.98)	1.0622*** (2.60)	1.0770*** (3.40)	1.0908*** (4.00)	1.0861*** (3.79)
TLI x sophistication (Z-stat)	1.0859 (0.28)	1.0914 (0.30)	1.1789 (0.56)	1.0641 (0.21)	1.1434 (0.46)
TLI x gender (Z-stat)	1.2257* (1.81)	1.2386* (1.90)	1.2759** (2.16)	1.2006 (1.62)	1.2438* (1.93)
Questionnaire item (Z-stat)	1.1511*** (3.88)	1.1104*** (2.91)	.9182** (-2.80)	.8747*** (-4.06)	.8810*** (-3.70)
Log estimated cumulative trades (Z-stat)	1.0772*** (5.83)	1.0746 (5.52)	1.0620*** (5.04)	1.0574*** (4.71)	1.0606*** (4.95)
Sophistication (Z-stat)	.6261** (-2.50)	.6170*** (-2.58)	.5889*** (-2.83)	.5786*** (-2.92)	.5796*** (-2.91)
Gender (Z-stat)	.8254*** (-3.04)	.8251*** (-3.04)	.8074*** (-3.36)	.8121*** (-3.29)	.8061*** (-3.40)
***, **, * - significant at 1,5 and 10% level					

AP8.2 Trading gain indicator with the Rational Experiential Inventory scales and subscales when additional control variables are considered

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Questionnaire variable	Experiential	Experiential ability	Rational preference	Rational ability	Rational
TLI (Z-stat)	2.6118*** (3.55)	1.4870 (1.44)	4.3400*** (6.66)	1.4673 (1.48)	2.6476*** (3.84)
TLI x questionnaire variable (Z-stat)	1.0542 (0.87)	1.2081*** (3.14)	.9194* (-1.62)	1.2146*** (3.49)	1.0554 (0.93)
Control variables					
TLI x log estimated cumulative trades (Z-stat)	.9325*** (-3.26)	.9518** (-2.28)	.9302*** (-3.59)	.9257*** (-3.85)	.9244*** (-3.91)
TLI x sophistication (Z-stat)	.8627 (-0.51)	.8715 (-0.48)	.8250 (-0.67)	.9433 (-0.20)	.8714 (-0.48)
TLI x gender (Z-stat)	1.0837 (0.75)	1.0725 (0.65)	1.0554 (0.50)	1.1126 (0.99)	1.0886 (0.79)
Questionnaire item (Z-stat)	1.0789* (1.66)	.9487 (-1.16)	1.0072 (0.18)	.7669*** (-6.38)	.8682*** (-3.22)
Log estimated cumulative trades (Z-stat)	1.1436*** (8.34)	1.1247*** (7.28)	1.1323*** (8.22)	1.1341*** (8.35)	1.1378*** (8.52)
Sophistication (Z-stat)	.6847* (-1.85)	.6712* (-1.95)	.6777* (-1.90)	.5954** (-2.52)	.6397** (-2.18)
Gender (Z-stat)	.8478** (-1.98)	.8566* (-1.85)	.8533* (-1.89)	.8171** (-2.42)	.8293** (-2.24)
***, **, * - significant at 1,5 and 10% level					

AP8.3 Trading loss indicator and emotion regulation variables when additional control variables are considered

	Reg 1	Reg 2
Questionnaire variable	Reappraisal	Expressive suppression
TLI (Z-stat)	.2063*** (-7.26)	.2350*** (-7.39)
TLI x questionnaire variable (Z-stat)	1.0786** (2.12)	1.0597* (1.74)
Control variables		
TLI x log estimated cumulative trades (Z-stat)	1.0907*** (4.01)	1.0878*** (3.87)
TLI x sophistication (Z-stat)	1.1387 (0.45)	1.1086 (0.35)
TLI x gender (Z-stat)	1.2139* (1.71)	1.2569** (2.02)
Questionnaire item (Z-stat)	.8761*** (-6.68)	.9787 (-1.17)
Log estimated cumulative trades (Z-stat)	1.0529*** (4.36)	1.0585*** (4.84)
Sophistication (Z-stat)	.6069*** (-2.67)	.6079*** (-2.66)
Gender (Z-stat)	.8610** (-2.35)	.8229*** (-3.08)
***, **, * - significant at 1,5 and 10% level		

AP8.4 Trading gain indicator and emotion regulation variables when additional control variables are considered

Questionnaire variable	Reappraisal	Expressive suppression
TGI (Z-stat)	3.5594*** (6.28)	4.7812*** (8.81)
TGI x questionnaire variable (Z-stat)	.9780 (-0.66)	.9056*** (-3.19)
Control variables		
TLI x log estimated cumulative trades (Z-stat)	.9271*** (-3.79)	.9262*** (-3.83)
TLI x sophistication (Z-stat)	.8233 (-0.68)	.8501 (-0.57)
TLI x gender (Z-stat)	1.0624 (0.56)	1.0497 (0.45)
Questionnaire item (Z-stat)	.9113*** (-3.61)	1.0512** (2.13)
Log estimated cumulative trades (Z-stat)	1.1292*** (8.11)	1.1354*** (8.38)
Sophistication (Z-stat)	.6963* (-1.77)	.6740* (-1.93)
Gender (Z-stat)	.8934 (-1.33)	.8696* (-1.66)
***, **, * - significant at 1,5 and 10% level		